SCIENCE ABSTRACTS.

Section A.—PHYSICS.

MARCH, 1932.

GENERAL PHYSICS.

669. Proposals for a Standard Measurement of Time. M. Schuler. *Zeits. f. techn. Physik,* 12. 12. *pp.* 678–684, 1931.—The author has investigated the wireless time signals from Nauen, using the new clock which he has recently described, in which the pendulum has no mechanical connections with the outside, the time signals being given by a beam of light, interrupted by it in one position, and the frictional losses being compensated electromagnetically. He finds for one set of Nauen signals a mean error of ± 0·041 sec. using Hamburg Observatory time, and 0·024 sec. using Greenwich Observatory. The author's clock gave for the mean daily variation of its rate ± 0·0019 sec. per day for 1930, and ± 0·0011 sec. for 1931. He proposes that a standard system of wireless time signals based on the new clock should be introduced. H. N. A.

670. Vapour Density of Hydrogen Sulphide. R. H. Wright and O. Maass. *Canad. J. of Research,* 5. *pp.* 442–447, *Oct.,* 1931.—An apparatus for the measurement of the vapour density of condensable gases at pressures greater than atmospheric and at various temperatures is described. The vapour density of redistilled hydrogen sulphide was measured at 47°, 25°, 0°, − 20° and − 35° C., and up to 4 atmospheres pressure. The interpolated value for the vapour density of hydrogen sulphide under standard conditions was found to be 1·537. This value agrees with the values given by Leduc (1·538) and Baume and Perrot (1·539), but the difference may be attributed in part to the neglect of the earlier experimenters to allow for deviations from the gas laws in correcting their values to standard pressure. The results are expressed as apparent molecular weights, and the deviations from the theoretical value shown to be due to the action of molecular attraction. AUTHORS.

671. Sensitive Direct-Reading Mercury Manometer. H. W. Melville. *Chem. Soc., J. pp.* 2509–2511, *Oct.,* 1931.—The manometer described consists essentially of a small inverted glass cup floating on mercury. When the pressure on the outer surface of the cup is increased the cup sinks further into the mercury. If Δx is the distance through which the cup moves and Δp the change of pressure, the sensitivity of the device is given by $\Delta x/\Delta p = r/2Kt\rho$, where r and t are the radius and wall thickness, respectively, of the cup, ρ is the density of mercury, and K is a constant. With $r = 1$ cm. and $t =$ about 10^{-2} cm., a pressure change of 2×10^{-4} mm. may be detected. H. F. G.

672. Measurements with the Pressure Balance. Part I. Influence of Pressure upon the Balance Constant. J. A. Beattie and W. L. Edel. *Ann. d. Physik,* 11. 5. *pp.* 633–644, *Oct.* 27, 1931.—Within a pressure range of 60–540 atmospheres no change in the constant could be detected. The average error in the determination of the constant was 1 in 10,000 approx. H. H. Ho.

673. Air Cushions as Supports for Instruments. E. Gehrcke and B. Voigt. *Zeits. f. techn. Physik,* 12. 12. *pp.* 684–686, 1931. *From the Reichsanstalt.*—Describes three different methods of combining air cushions with R. Müller's apparatus, to prevent the transmission of vibrations to a table on which apparatus is to be placed. The Müller apparatus absorbs the horizontal tremors satisfactorily, while the air cushions absorb vertical components. Three tennis balls placed at the corners of an equilateral triangle, a pair of rubber air cushions (ring-formed) placed one above the other, or a small inner tube from a motor tyre, laid horizontally on the top of a larger inner tube, are employed in three different forms of apparatus designed by the authors. H. N. A.

674. Simple Method of Measuring Surface Tension. J. H. Gaddum. *Roy. Soc., Proc.* 133. *p.* 695, *Oct.* 1, 1931.—The surface tension of a liquid can be determined in absolute units by measuring the volume of drops by means of the micrometer syringe. The slow fall of " static " surface tension in the newly-formed surface of a solution of a hydrophilic colloid can be followed by this method. The apparent viscous-elasticity of the surface of saponin solutions is clearly shown by the changes which occur in the shape of drops. The rapid changes can be explained in terms of the changes which must occur in the concentration of saponin in the surface. It is suggested that the slow changes are due to the diffusion of saponin. It is suggested that the slow changes which occur in the tension of certain plastic bodies following a strain may also be due to the diffusion of molecules into positions where they affect the tension. AUTHOR.

675. Variation in Surface Tension of Gas-Saturated Petroleum with Pressure of Saturation. C. A. Swartz. *Physics,* 1. *pp.* 245–253, *Oct.,* 1931.—The surface tension of a number of samples of crude petroleum has been measured, by the capillary rise method, as a function of the pressure at which the oil is saturated with gas. Oils and natural gases were used which were obtained from various fields throughout the country. Carbon dioxide, air and benzene were also used. The oils were saturated with the gases at various pressures up to 2000 lb./sq. in. at a temperature of 31° C. (88° F.), and curves obtained to show how the surface tension varies with the saturation pressure. The results show that in all cases curves of the same general type are obtained, and at 2000 lb. pressure the surface tension has decreased by more than 50 %. In one case the decrease was as much as 80 %. AUTHOR

676. Adhesion of Lubricants. A. Boutaric and R. Amiot. *Comptes Rendus,* 193. *pp.* 593–594, *Oct.* 12, 1931.—Metallic plates were slowly immersed in lubricating oil, and slowly withdrawn. Curves were taken of the variation with time of the weight of oil remaining adherent to the metal plate. These curves are of a hyperbolic order, and stand in the order of decreasing viscosities; and they approach a limit which represents the weight of the oil definitely adhering to the metal. This weight increases regularly with the viscosity for the mineral oils; for equal viscosities it is slightly greater for mineral than for vegetable oils [compare Woog, Abstract 432 (1926)]. On centrifugation, let the initial weight of oil on the plate be p_0, and the final weight left on after long centrifugation be π, then the weight p left on at the end of a period t of centrifugation is governed by the relation $1/(p - \pi) = 1/(p_0 - \pi) + mt$. For oils only faintly acid, these quantities p_0, π and m are sensibly independent of the nature of the support, and appear to depend only on the viscosity. They remain much the same for different qualities of oil. Acidity of the oil brings about, for iron and copper—not for aluminium or inoxidisable steel—an increase in the value of π, the finally adherent weight. A. D.

677. Cylindrical Vortices of Finite Section. J. Rossignol. *Comptes Rendus*, 193. *pp*. 700–703, *Oct*. 26, 1931.—The configuration of a cylindrical vortex pair having vertical axes and moving in an incompressible non-viscous fluid is discussed mathematically. J. S. G. T.

678. Turbulence and Mechanism of Resistance to Flow by Spheres and Cylinders. F. Ahlborn. *Zeits. f. techn. Physik*, 12. 10. *pp*. 482–491, 1931.—The nature of turbulence is discussed with reference to photographic results relating to the flow of water past lattices, spheres and cylinders in channels. It is shown that rotary turbulence produced in the case of spherical obstacles is not attributable to the incidence of turbulence within the boundary layers as required by Prandtl's theory. The investigation of the analogous case of a cylinder shows that the onset of rotary turbulence is accompanied by a complete transformation of the whole field of flow. Rotary turbulence in a homogeneous vortex-free stream originates owing to the incidence of an approximately symmetrical and stable circulation upon the obstacle at the critical velocity and assuming a labile state which passes into a stable but unsymmetrical form comprising a vortex street. J. S. G. T.

679. Velocity Distribution in Air Stream near a Grating. B. G. van der H. Zynen. *K. Akad. Amsterdam, Proc*. 34. 6. *pp*. 847–865, 1931.—Describes experiments on the air flow surrounding a grating composed of knitting needles 0·3 cm. in diameter and 1 cm. apart. The air speeds used were 800, 1200, 1600 and 2400 cm. per sec., and the velocity distribution, the shearing stress and the characteristic length in the boundary layer were determined at all these speeds. The results are shown graphically. J. W. T. W.

680. Cubic Compressibilities of Certain Substances. L. H. Adams and R. E. Gibson. *Washington Acad. Sci., J*. 21. *pp*. 381–390, *Oct*. 4, 1931.—The compressibilities of (*a*) pyrex glass, vitreous silica, obsidian, duralumin; (*b*) ammonium nitrate, potassium sulphate, sodium sulphate; (*c*) *n*-butyl ether, are determined by comparison with Bessemer steel, up to a pressure of 12 kilobars. The results for substances (*a*) are in substantial agreement with the determinations of Bridgman. The compressibility of duralumin is practically independent of pressure. The solid salts (*b*) have smaller compressibilities at high pressures than at low; while with substance (*c*) the compressibility decreases very rapidly as the pressure is first increased, but less rapidly at high pressures. J. P. A.

681. Relaxation Times for Solids. A. Esau. *Zeits. f. techn. Physik*, 12. 10. *pp*. 492–495, 1931.—A formula derived by R. Becker [see Abstract 2211 (1925)] for the logarithmic decrement of an oscillation in solid materials, contains as a parameter the relaxation time $1/R$, which may therefore be determined from experiments on damping. Torsional oscillations in wires of brass, duralumin and electron metal are employed; and for these three, R has the values 750, 1500 and 50–100 sec.$^{-1}$, respectively. The numbers vary in a somewhat complicated way, however, with the frequency of oscillation. Determinations of R from measurements of elasticity, while theoretically possible, are in practice far too difficult and inaccurate. J. P. A.

682. Application of Integral Equations to Plane Stress Problems. E. Weinel. *Zeits. f. angew. Math. u. Mechanik,* 11. *pp.* 349–360, *Oct.*, 1931.—Beginning with the Airy stress-function, the elastic theory for a two-dimensional body is formulated in a manner suited to development by means of integral equations. In terms of such equations, the distributions of stress and displacement for boundary conditions of a usual character are then worked out. Numerical methods may be adopted to solve these equations. The advantage of the integral equation method derives from the direct appearance of the required quantities in the solutions of the equations. This is exhibited in the general theory of elastic plates, given in the paper. J. P. A.

683. Initial Stresses in Photoelasticity. M. v. Laue. *Preuss. Akad. Wiss. Berlin, Ber.* 21. *pp.* 377–382, 1931.—The double refraction sometimes exhibited by a transparent, undeformed and, on the whole, isotropic body is always taken as a measure of the initial stresses. This involves the assumption that initial stresses are of the same nature as those produced by deformation of the whole body. If this is correct they are due to local deformations which would disappear were the body subdivided. The paper shows (mathematically) that on subdividing such a body, the energy density due to stress continually decreases. If a small specimen is divided into N^3 similar elements, the mean energy density of these elements is $1/N^4$ of that of the original specimen. As the method is a very general one, this is evidence that initial stresses are of the same nature as those due to deformation. J. P. A.

684. Calculation of Critical Speeds of Rotating Shafts. T. Got. *Comptes Rendus,* 193. *pp.* 706–708, *Oct.* 26, 1931.—A graphical method of determination of the critical speeds of rotating shafts of constant cross-section and appreciable mass loaded with perfectly centred thin discs is briefly discussed. The analysis leads to two different series of critical speeds. [See also following Abstract.] J. S. G. T.

685. Values of Dunkerley's and Analogous Formulæ for the Approximate Calculation of the First Critical Velocity of Flexure of a Rotating Shaft. T. Got. *Comptes Rendus,* 193. *pp.* 836–839, *Nov.* 9, 1931.—In continuation of previous work [see preceding Abstract] the author points out that formulæ recently proposed by Hahn and by van den Dungen are not to be preferred to Dunkerley's original formula [*Roy. Soc., Phil. Trans.* 185. *pp.* 279–360, 1894]. J. S. G. T.

686. Fundamental Equation of External Ballistics. M. Kourensky. *Comptes Rendus,* 193. *pp.* 571–572, *Oct.* 12, 1931.—There are three actual methods for the solution of the fundamental equation of exterior ballistics, (1) the Gavre method, (2) the method of Dufrenois and Rousier and (3) the M.G.N. method making use of the laws of air resistance, which

are a particular case of the general law enunciated in the present paper and correspond to the fundamental equation (reduced to canonical form) $dY/dX = Y^2 + J(X)$, where the function J(X) is the absolute invariant.
S. G. B.

687. Theory of Probabilities. G. Pólya. *Annales de l'Inst. H. Poincaré,* 1. 2. *pp.* 117–161, 1931.—The first part of this shortened account deals with a characteristic property of Gauss' law, the second deals with other laws governing the occurrence of events. The latter resemble the law of Gauss in also resulting from the superposition of a great number of small effects due to chance, but they differ from the law of Gauss in that these effects are not independent in their case. Detailed calculations are given.
H. L. B.

688. Fundamental Theorem in the Theory of Errors. P. Lévy. *Annales de l'Inst. H. Poincaré,* 1. 2. *pp.* 163–175, 1931.—Accidental errors in the measurement of physical quantities are defined and are contrasted with systematic errors. The accidental error is shown to arise from the combination of very small and independent errors. The sum of *n* such errors, whose individual probable values are zero, obeys a law which approximates to that of Gauss when *n* tends to infinity. Certain conclusions about the compensation of errors are discussed in the last paragraph.
H. L. B.

689. Clarity of Expressions in Technical Scientific Work. J. Wallot. *Zeits. f. techn. Physik,* 12. 11. *pp.* 559–560, 1931.—Takes up the question raised by Schack [see Abstract 1065 (1931)], discussing two particular examples, and pointing out that the suggestions of the German Committee for Units and Symbols (the A.E.F.) would obviate possible misconceptions.
J. H. A.

690. Crystal Structure of Nitrogen Tetrasulphide and Tetra-Hydro-Nitrogen Tetrasulphide. F. M. Jaeger and J. E. Zanstra. *K. Akad. Amsterdam, Proc.* 34. 6. *pp.* 782–807, 1931.—The crystal structures of nitrogen tetrasulphide (N_4S_4) and tetra-hydro-nitrogen tetrasulphide ($H_4N_4S_4$) are investigated by the powder method of X-ray analysis and by rotation and oscillation photographs. They are found to be very similar. The "plane" ring structure, which had been previously supposed to be present from chemical evidence, does not occur in either case. The unit cell of each crystal is orthorhombic, the space group being V_4^1. The molecules of N_4S_4 and $H_4N_4S_4$ are found to be present as such within the elementary cell. They have the symmetry C_{2v}, and consist of two interpenetrating distorted tetrahedra of nitrogen and sulphur atoms. The molecule of $H_4N_4S_4$ is more loosely packed than that of N_4S_4 owing to the presence in it of four hydrogen atoms. Their exact positions, however, cannot be determined. There are four molecules per unit cell in each case. The lattice constants are:—

N_4S_4 $a = 8{\cdot}87$ Å. $b = 8{\cdot}47$ Å. $c = 7{\cdot}2$ Å.
$H_4N_4S_4$ $a = 12{\cdot}08$ Å. $b = 6{\cdot}76$ Å. $c = 7{\cdot}86$ Å.
J. T.

691. X-Ray Examination of Arabinose, Xylose and Rhamnose. E. G. Cox. *Chem. Soc., J. pp.* 2313–2323, *Sept.,* 1931.—The available data regarding the structure of the sugar ring were reviewed by Astbury and Marwick (*Nature,* 127. p. 12, 1931), who suggested that the six-atom sugar ring has in the crystalline state approximately constant dimensions, being about 4·5 by 5·5 by 7·5 Å., the first dimension being that normal to the ring. At present, however, it is almost impossible to interpret such results as these in terms of the structure of the molecule. Considerations of space-filling alone are not enough to decide between the various possible structures, since the knowledge of atomic diameters in organic compounds is too scanty. Neither the diameter of the O atom when singly bound to C, nor that of the H atom in such compounds is known. Hence, almost any of the possible models for a sugar molecule can be made to fit figures such as those quoted above. If, however, similar data were available for several series of closely related carbohydrates, it would be possible to find the effect of additional groups in various positions, and the size and mode of attachment of these groups might be inferred. Preliminary data for α-xylose, β-arabinose and rhamnose hydrate are now given. T. H. P

692. X-Ray Analysis of the Structure of Hexachlorobenzene, Using the Fourier Method. K. Lonsdale. *Roy. Soc., Proc.* 133. *pp.* 536–552, *Oct.* 1, 1931.—The unit cell of hexachlorobenzene is simple monoclinic prismatic with $a = 8 \cdot 07$, $b = 3 \cdot 84$, $c = 16 \cdot 61$ Å., and $\beta = 116° 52'$; it contains two molecules of C_6Cl_6. The space group is probably $C_{2h}^{5}(P2_1/c)$. Each carbon atom appears to be roughly triangular, indicating polarisation in the direction of its appropriate chlorine atom and of the two neighbouring carbon atoms. No polarisation towards the centre of the benzene ring is indicated, nor any polarisation of the chlorine atoms. It is shown conclusively that all the atoms of the molecule do not lie in the same plane. Moreover, it is not possible to say whether the carbon atoms of the benzene ring in this compound are in the same plane or not. If they are, then the distance between them is 1·42 Å., which is the value found in graphite and hexamethyl benzene. F. J. W.

693. Two-Dimensional Crystals. N. Fuchs. *Zeits. f. phys. Chem.* 14. *Abt.B.* 3–4. *pp.* 285–289, *Oct.*, 1931.—The gradual formation of a thin film of the paraffin $C_{34}H_{70}$ on the surface of a 5 — 1 μ thick layer of a saturated solution in liquid paraffin has been studied microscopically. Full development of the crystalline film requires at least 2–3 days at 16° C., and there is an induction period of up to several days, according to the concentration of the solution. The thickness of the film is $3 \cdot 9 \pm 0 \cdot 4\ m\mu$, which approximates to the length of the $C_{34}H_{70}$ molecule, and the film is thus composed of molecules oriented perpendicularly to the surface of the solution. Such crystalline layers are described as two-dimensional. The theory of their formation is discussed briefly. H. F. G.

694. Architecture of the Solid State. W. L. Bragg. *I.E.E., J.* 69. *pp.* 1239–1244, *Oct.*, 1931. *Kelvin Lecture.*—A general account of recent theories of the solid state. Solids are divisible into three great classes: metals, organic substances and inorganic substances. Free electrons, under attractive forces by positive ions, give metallic structures their stability. Close-packing is the rule for metals and alloys, with atomic radii larger than the corresponding quantities in other crystals. Mica is a typical example of an inorganic compound; it is conceived as an electrical condenser. The strength parallel to the sheet is very great, but extremely low in the perpendicular direction. F. I. G. R.

695. Periodic System of Atomic Nuclei and the Principle of Regularity and Continuity of Series. W. D. Harkins. *Phys. Rev.* 38. *pp.* 1270–1288, *Oct.* 1, 1931.—New relations which concern the existence and stability of atomic nuclei are brought forward; and the new data on the existence of isotopes are discussed in connection with the relations previously found by the author. The four series 4M, 4M + 1, 4M + 2 and 4M + 3 exhibit a considerable amount of regularity, and are now almost continuous. Considerable use is made of the author's "isotopic numbers," and graphs in which these are plotted against the atomic numbers are shown to be useful. The regularities found in these graphs enable many undiscovered atomic species (isotopes of each element) to be predicted, between atomic numbers 61 and 18, and a considerable number for lower atomic numbers. Fourteen rules governing these relations are given, several of which are new. Nuclear stability and abundance are discussed; also the possible part played by neutrons, or nuclear neutral particles, in atom building. Atomic nuclei are apparently built in steps, and, except in the simplest cases, not in single events. This appears to disagree with the theory of Millikan and Cameron. H. N. A.

696. Isomorphous Substitution of Non-Polar Bound Atoms and Atomic Groups. H. G. Grimm, M. Günther and H. Tittus. *Zeits. f. phys. Chem.* **14.** *Abt.B.* **3–4.** *pp.* **169–218,** *Oct.*, **1931.**—The isomorphous replaceability according to the hydride displacement law has been established from forty-four pairs of organic substances for the following groups: $-\mathrm{OH}$, $-\mathrm{NH_2}$, $-\mathrm{CH_3}$, $-\mathrm{Cl}$, $-\mathrm{Br}$, $-\mathrm{O}-$, $-\mathrm{NH}-$, $-\mathrm{CH_2}-$, $-\mathrm{S}-$, $-\mathrm{N}=$, $-\mathrm{CH}=$, $-\mathrm{CH}=\mathrm{CH}-$, $-\mathrm{CH_2}-\mathrm{CH_2}-$. In a number of cases this could be established by mixed crystal formation from the melts, three different methods having been employed for this purpose. In a number of examples, however, mixed crystal formation did not occur; the reasons for which have not yet been deduced. The available data on this subject in the literature has been rearranged and discussed alongside the new results. H. H. Ho.

697. Equation of Quantum Mechanics. J. L. Destouches. *Comptes Rendus,* **193.** *pp.* **518–521,** *Oct.* **5, 1931.**—The problem of integrating the differential equation $HU - x dU/dt = 0$, where $x = -h/2\pi i$ and H and U do not satisfy the usual commutative rules, is considered. The case when H is independent of t has been solved by previous investigators, and the present author extends the work to the case when H is an analytic function of t and U itself is assumed to be an analytic function of t. If H is commutable with $\int H \, . \, dt$ the solution is obtained by the transformation $U = e^x$, where X is a new variable. In the general case, when H is any analytic function of t, it is shown how to obtain U as a series of terms in powers of t, provided certain commutative conditions are satisfied. N. D.

698. Multiplet Production by Coupling of Two Vectors. H. A. Kramers. *K. Akad. Amsterdam, Proc.* **34. 7.** *pp.* **965–976, 1931.** *In German.*—A mathematical paper dealing with multiplet production from the point of view of quantum mechanics. F. S.

699. Potential Fields with Two Minima. P. M. Morse and E. C. G. Stückelberg. *Helv. Phys. Acta,* **4. 5.** *pp.* **337–354, 1931.** *In German.*—A mathematical paper dealing with the proper frequencies of polyatomic molecules such as NH_3. The results are compared with those given by Dennison's approximation method [see Abstract 3062 (1931)]. F. S.

700. Equilibrium Between Radiation and Matter. D. S. Kothari. *Phil. Mag.* 12. *pp.* 657–664, *Sept.*, 1931.—On the basis of Fermi-Dirac statistics it is shown that if matter is in equilibrium with radiation the matter cannot be a degenerate gas. It is assumed that matter is being turned into radiation in such a manner that an electron and proton are always converted into radiation simultaneously, and that this process is reversible. G. C. McV.

701. Value of the Cosmical Constant. A. S. Eddington. *Roy. Soc., Proc.* 133. *pp.* 605–615, *Oct.* 1, 1931.—It is argued that, owing to the curvature of space, a term $i\sqrt{N}/R$ should appear in the wave equation for an electron, N being the number of electrons in the universe and R the radius of the universe in an eigenstate, and having therefore the dimensions calculated for an Einstein world. The units are here supposed to be such that the electrostatic energy of two electrons at a distance r is simultaneously represented by a term i/r. The theoretical term is identified with the term ordinarily attributed to the proper-mass of the electron. From this identification we find the cosmical constant $\lambda = 9\cdot 79 \times 10^{-55}$, which gives a speed of recession of the spiral nebulæ 528 km. per sec. per megaparsec. The observed speed according to Hubble is 465 km. per sec. per megaparsec. AUTHOR.

702. Theory of Michelson Relativity Experiments. E. Papperitz. *Zeits. f. Physik,* 72. 3–4. *pp.* 226–239, *Oct.* 14, 1931.—The author believes that it is not on account of physical reasons that the experiments so far made on ether-drift have been inconclusive. He believes that the experiments so far made have been based on misconceptions. He starts by taking account of the reflection of light at moving mirrors, and in the light of this modifies and extends the theory of the Michelson interferometer for ether-drift investigation. Fresnel's theory of a stationary ether has to be modified in certain particulars (which concern the relationship of ether and moving matter) in order to interpret any experiment. It is believed that the ether can and should be regarded as a fixed frame of reference, and the difficulties then disappear. A form of experiment which should be crucial is advocated. A. C. M.

703. Cosmological Problem in General Relativity. A. Einstein. *Preuss. Akad. Wiss. Berlin, Ber.* 12. *pp.* 235–237, 1931.—The "cosmological constant," λ, was originally introduced into the equations of general relativity to make it possible to obtain "stationary" universes such as those of Einstein and de Sitter. If the requirement that the universe should be stationary is removed we can dispense with λ and use the equation $G_{\mu\nu} = 0$ for cosmological purposes. The resulting solution, applicable to the universe as a whole, is that of a spherical space with radius oscillating between two extreme values with the lapse of time. The rate of expansion of the nebulæ gives the fractional rate of increase of the radius at the present moment. As in the case of Lemaître's expanding universe, the time elapsed since the expansion effectively began, to the present day, is very short compared to the apparent ages of the stars. G. C. McV.

704. Special Theory of Relativity and Quantum Mechanics. E. Schrödinger. *Preuss. Akad. Wiss. Berlin, Ber.* 12. *pp.* 238–247, 1931. —The construction of a dynamical theory which shall embrace both special relativity theory and quantum mechanics involves something more than the obtaining of equations in quantum mechanics which are invariant under Lorentz transformations. For in relativity theory the time is treated on exactly the same footing as the three space-coordinates, but this is not so in quantum mechanics. In the latter, whereas we can always speak of the "uncertainty" in the value of a coordinate, it appears meaningless to speak of the "uncertainty" in the time at which an observer wishes to make the observation. The argument is developed that any clock which could measure the time used in quantum mechanics cannot exist. But it is a fundamental assumption, in establishing Lorentz coordinate-systems, that time-measuring clocks do exist. No way out of these difficulties appears as yet. G. C. McV.

705. Compatible Field-Equations. A. Einstein and W. Mayer. *Preuss. Akad. Wiss. Berlin, Ber.* 14. *pp.* 257–265, 1931.—A general method for deducing all sets of compatible field-equations in the theory of parallelism at a distance is worked out. The field-equations are derived from the fundamental divergence identity of the theory, under the restriction that the second derivatives of the field variables must appear linearly, and the first derivatives in quadratic terms. In this way, four non-trivial sets of field-equations are found to exist, of which two sets yield field-equations that are generalisations of the original field-equations of relativity. G. C. McV.

706. Equations of a Unified Field Theory. P. Straneo. *Preuss. Akad. Wiss. Berlin, Ber.* 18. *pp.* 319–325, 1931.—The equations of a unified field theory of a closed system satisfying the gravitational and Maxwellian equations as limiting cases are derived. The basis of the theory is the assumption of simultaneous curvature and torsion of the space-time manifold, and differs from the theories of Weyl, Eddington and others in which curvature alone of the manifold is considered, and from the recent form of Einstein's theory which introduces only torsion of the manifold. J. S. G. T.

707. General Field-Equations. K. Novobatzky. *Zeits. f. Physik*, 72. 9–10, *pp.* 683–696, *Oct.* 30, 1931.—Field-equations are set up in a manifold with affine connection, the coefficients of the connection being the sum of the Christoffel symbols of the metric and the components of a third-rank antisymmetric tensor. The field-equations themselves arise from the Hamiltonian differentiation of a suitably chosen invariant. These equations have a statical solution which is interpreted as corresponding to the field of an electrically-charged particle. G. C. McV.

METEOROLOGY, GEOPHYSICS AND ASTROPHYSICS.

708. Transparency of the Atmosphere for Solar Radiation. W. Gorczynski. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 1.) 32. *pp.* 47–62, 1931.—A series of values of the solar radiation, Q_m, for varying equivalent thicknesses, m, of atmosphere passed through, is calculated for dry air. The absolute percentage transparency, P, is then defined as $100(1 \cdot 94 - Q_m)/(1 \cdot 94 - Q_{obs})$, Q_{obs} being the observed radiation corrected to average solar distance. The amounts A_m, by which Q_m should be diminished so as to represent the radiation received through a thickness m of pure air containing the amount of water vapour present in the driest natural air, is then determined. The relative value of P, P_{rel}, is then defined as $100\{1 \cdot 94 - (Q_m - A_m)\}/(1 \cdot 94 - Q_{obs})$. Numerous tables are given and examples for many places worked out, the relative transparency averaging 39 % in European, and 34 % in equatorial latitudes near sea-level, and increasing rapidly with height to, *e.g.*, 50 % at 1000 m. and 62 % at 2000 m. C. A. S.

709. Transparency of the Vapour-Laden Atmosphere. O. Hoelper. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 2.) 33. *pp.* 370–386, 1931.—Taking as a basis the recent data concerning the distribution of the extra-atmospheric energy from the sun and the transparency of the atmosphere for monochromatic radiation, the extinction coefficient for the total radiation which can pass through a filter RG. 2 is considered for dry and damp air as a function of the mass of the air. If the unit (dimming-factor) is taken as the ratio of the complex extinction factor to the molecular extinction, this is not a true physical interpretation of what occurs, because different parts of the radiation-diminution follow different laws according to the position of the sun and the mass of the air. So it is impossible adequately to compare the dimming factor at places of different height or position. The complex extinction coefficients obtained experimentally are obtained by adding together the different parts of the radiation diminution. This deduction of the diminution due to molecular scattering, vapour extinction and absorption, gives the dimming factor as the excess of the variable optical diminution above the normal decrease in radiation. Daily and yearly changes, with dependence upon height above sea-level and unperiodic atmospheric occurrences, are observed and discussed. H. M. B.

710. Solar Radiation Intensities in Arctic Regions. H. H. Kimball. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 1.) 32. *pp.* 100–105, 1931. *In English.*—A summary is given of pyrheliometric measurements in the Arctic regions, the solar radiation intensities at normal incidence being tabulated for Abisko, Jokkmokk, Mt. Evans, Rovaniemi and Treurenberg, while for Green Harbour, Svalbard, values for direct and indirect solar radiation are given. At Mt. Evans, Greenland, there is a high atmospheric transmission compared with all other Arctic stations, and after making allowances for the loss due to scattering and absorption associated with moist air, there remains a loss of only 3 % of the solar constant due to dust particles. For the three weeks around the summer solstice the average daily receipt of radiation on a horizontal surface at Green Harbour exceeds the normal rate for the same period at any station in the United States, except Twin Falls, Idaho, and Fresno, California. R. S. R.

711. Blue of the Sky and Turbidity Factor. F. Lauscher. *Gerlands Beitr. z. Geophys.* (*Köppen Band*, 1.) 32. *pp.* 106–112, 1931.—Simultaneous observations of the intensity of solar radiation and estimates of the blueness of the sky according to the Ostwald-Linke scale were made in 1930 in Vienna, Breslau, Taunus, Potsdam, Wyk, Wahnsdorf and Schomberg. These give a relation between the coefficient of turbidity (T) and the blueness (B) of the sky in the form $B = 13 \cdot 5 - 18 \cdot 2 \log T$. R. S. R.

712. Activity of a Large Town as a Source of Atmospheric Pollution. H. Lettau. *Gerlands Beitr. z. Geophys.* 31. 4. *pp.* 387–397, 1931.—Measurements were made at a number of places in and close to Koenigsberg of the intensity of the blue of the sky on October days with cloudless skies using the Ostwald-Linke blue scale. The gradient of the intensity down wind was found, its relation to the dust content depending on the turbulence. Schmidt obtained a solution of the distribution of particles in time and space when emitted from a point in a stream of air. The author deals with the general case, proceeding from the observed distribution, but only particles having an optical effect can be considered. Taking an initial dust content in an undisturbed region of 500 particles/cm.^{3} and for a mean turbulence and wind speed, he finds 10^{18} particles are released over the whole city on a given day. In spite of difficulties in the physical criterion employed, the result is of the same order of magnitude as that found by Schmidt for Vienna. R. S. R.

713. Improved Form of Michelson-Marten Bimetal Actinometer. W. Marten. *Gerlands Beitr. z. Geophys.* (*Köppen Band*, 1.) 32. *pp.* 69–82, 1931.—The newest form of actinometer, with directions for use, is described. The instruments are independent of temperature and quite constant. High exactitude of measurement is combined with simple handling. The measuring system of thin metal plates is insensitive to shaking or wind. The instrument is portable. H. M. B.

714. Registration of Radiation from Sun and Sky with Cuprous Oxide Cells. A. Ångström. *Gerlands Beitr. z. Geophys.* 31. 4. *pp.* 438–443, 1931. *In English.*—All radiation reaching the cell (Siemens cuprous oxide) passes through frosted glass and then through yellow OG_1 glass. The combination limits the effective radiation to between λ 5100 and 6250, with a maximum at about 5500. Measurements with filters of glasses OG_1, OG_2 and RG_2, and by the pyrheliometer are compared. It is considered probable that the cell may be adapted for meteorological radiation measurements. [See also following Abstract.] C. A. S.

715. Transparency to Radiation of Moist Frosted Glass. A. Ångström. *Gerlands Beitr. z. Geophys.* 31. 4. *pp.* 435–437, 1931.—The effect of moistening the ground-glass cover to the box containing the cell [see preceding Abstract] is investigated. With the sun at heights of 39·5°, 24° and 10° such moistening causes, respectively, increases of 15 and 1–2 % and a decrease of 15 % in the recorded radiation. The results are in agreement with those theoretically deduced from the fact that the surface is water instead of glass. C. A. S

716. Sun Orientator. W. H. Connell. *Journ. Sci. Instruments*, 8. *pp.* 328–329, *Oct.*, 1931.—The instrument consists of a flat plate of metal inscribed with compass directions, on which is fixed obliquely a half ring of metal. The obliquity and width depend on the latitude at which it is to be used. Hours are marked on both edges, those on the upper for "summer" (accurate for 23/5 and 15/7), on the lower for "winter" (accurate for 24/11 and 18/1). When a cord attached to the centre of the plate is pulled tight so as to touch an edge of the half ring, it shows the sun's direction at the hour indicated. A model for 52° N. is sufficiently accurate for latitudes 50–54° N. C. A. S.

717. Cause of Small Correlation between Atmospheric Ozone Content and Meteorological Conditions. Helge-Petersen. *Gerlands Beitr. z. Geophys.* (*Köppen Band*, 1.) 32. *pp.* 428–433, 1931.—Chapman and Milne showed that the coefficient of kinematic viscosity is very great at great heights on account of the decrease of density, but meteorological observations show that it decreases rapidly from the ground upwards when surface eddy motions are lost. There is thus an intermediate layer of small kinematic viscosity, with the ground value reached again at 60 km. The author supposes that a raising or lowering of corresponding surfaces at the tropopause will be followed by a decrease or increase of O_3. These motions will result from cyclonic or anticyclonic changes, and they are supposed to extend into the stratosphere. These facts are used for a comparison with the conclusions drawn by Dobson [see Abstract 1117 (1931)] regarding correlations between ozone content and meteorological conditions. R. S. R.

718. Constitution and Temperature of the Stratosphere. B. Gutenberg. *Gerlands Beitr. z. Geophys.* (*Köppen Band*, 1.), 32. *pp.* 87–94, 1931.—Recent investigations regarding the stratosphere are discussed [see Abstracts 1463 and 1797 (1929), 1358 (1930), 58 (1931)]. Two sets of density/height curves are worked out based on Lindemann and Dobson's results from meteorites, and on the assumption of diffusion equilibrium above a certain height, with different temperature gradients and atmospheric compositions. Comparison of these shows (1) that the atmosphere probably has the same composition up to at least 150 km., (2) that above 150 km. the proportion of oxygen decreases slowly, whilst that of water vapour or helium increases a little and (3) that the temperature of the stratosphere is of the order of 500–1000° C. C. A. S.

719. Thermal Cyclogenesis by Superposed Stratospheric Pressure Changes. R. Becker. *Gerlands Beitr. z. Geophys.* (*Köppen Band*, 1.) 32. *pp.* 260–267, 1931.—The author considers Stuve's conceptions regarding motion by waves in the stratosphere. He seeks a comparison of the energy transposed at the setting up of the pressure field and the kinetic energy set free in the whole space of the cyclone during its development. An equation is obtained giving the height of a surface rise or fall when the surface pressure is raised or lowered. In a table numerical values of the height changes are set out for a surface pressure (p_0) of 1000 mb., a pressure (p_h) at the height of the given surface of 200, 400 and 600 mb., and Δp_0 of 2, 4 and 6 mb. These results are extended to the resulting motion set up in the air column, and the vertical velocities are given with p_0, p_h and Δp_0 having the same values as before. Thus for a height of 12,876 m. and a pressure there of 200 mb., if heavier air entered the column and increased the surface pressure by 4 mb., the resulting vertical velocity is 22·34 m./sec. R. S. R.

720. Periods of Independent and Non-Independent Weather. A. Schmauss. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 2.) 33. *pp.* 1–15, 1931.—The variations from the daily mean temperatures, grouped into five-day periods, at Hohenpeissenberg (Bavaria) are plotted against the frequency of their occurrence. Hence it appears that at certain times there are variations which appear to have a definite and regular existence, and not to be merely the result of chance fluctuations. It is further concluded that the weather there is as a rule not the independent result of local conditions, but is largely due to the passage of definite bodies of air from elsewhere. C. A. S.

721. Correlation of Monthly Air-Temperature Anomalies of Selected Poles with those of Other Places. L. W. Pollak. *Gerlands Beitr. z. Geophys* (*Köppen Band,* 2.) 33. *pp.* 70–111, 1931.—Monthly simultaneous and successive temperature anomalies for January and July for 45 places distributed over the globe, and annual average temperatures for 60, are correlated with those of Prague, Stykkisholm (Iceland) and Nerchinsk (N.E. Siberia). A simplified method of calculating correlation coefficients is given, and the anomalies for January and July analysed harmonically, and charts given showing lines of equal correlation. A coefficient $> 0 \cdot 4$ is " large," of 0·4–0·2 " moderate," and $< 0 \cdot 2$ " small." From the results it is concluded that a long-term forecast for January temperatures of Central Europe can be deduced from the figures for the late summer and autumn of India and Indo-China, more especially from those of September for northern Indo-China; and (less reliably) for July on those of March for N. America and Persia, more especially of Iceland.
C. A. S.

722. Temperature Effects at Different Heights in the Air in Relation to Sunspots. S. Hanzlik. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 1.) 32. *pp.* 226–230, 1931.—The differences in reduced pressures at 53 pairs of places as near as possible together but differing in height by at least 300 m., are averaged over 3-year periods, 1877–1879 to 1917–1919, and these averages, which are regarded as a measure of the temperature change between the two stations of a pair, averaged for periods of maximum and minimum of sunspots—1877–1884, 1888–1894, 1900–1907 and 1911–1919. The four sets of averages are plotted against height difference, and show that the oscillations of mean temperature follow the Hales period, and that this period is due to some cause operating below a height of 3 km. [See Abstract 2600 (1931).] C. A. S.

723. Main Characteristics of Yearly Temperature Changes. O. V. Johansson. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 2.) 33. *pp.* 406–428, 1931.—Gorczynski has given the degree of continentality in the form $k = pA/\sin \phi - q$, where A is the amplitude, ϕ the latitude and p and q constants. Taking v and h as the percentage deviations of temperature from the normal curves for spring and autumn, and using $d = \frac{1}{2}(h - v)$ and $m = \frac{1}{2}(h + v)$ values are set out for k, d (displacement of the yearly curve) and m (asymmetry of the yearly curve) for each 5° of latitude between 5° N. and 65° N. and 10° of longitude between 10° W. and 180° E. Extrapolations are made where necessary. The general variations of d, v and k over the whole area are discussed. Mean values are then obtained at 50°–55° N. and 10°, 30°, 60°, 90° and 120° E. to get the percentage changes with longitude from the eastern Atlantic to East

Siberia. For latitude, 5° changes over the five continents are found, and values of *k*, *v*, *h*, *d* and *m* tabulated for (1) each continent for each 5°, (2) mean values for each continent and (3) mean values for various parts of the world for all latitudes. Similar values are set out for various islands and coastal towns. Nine types or sub-types are arranged according to +, 0 or − values of *v* and *h*, and these provide a ready review for the oceans and continents. These are reduced to five groups (polar, oceanic, normal, tropical and equatorial), and their features are discussed. In general they differ little from Köppen's, but their derivation provides a systematic and reliable review of an important branch of climatology.
R. S. R.

724. Year to Year Variation of Temperature. K. F. Wasserfall. *Geofysiske Publ.* 9. 2. [12 *pp.*], 1931.—The temperature data for Oslo and Bergen for the years 1816–1920 are tabulated for winter (Dec.–Feb.), and summer (June–Aug.), and discussed. A two-year period is fairly apparent, resulting in alternations of hot and cold winters (or summers), such alternations continuing for from 2 to 19 years in succession, but on what the length of such successions depends is doubtful; possible connections with sunspots or conjunctions of Venus and Jupiter are mooted. There seem indications that a mild winter is more often followed by a warm summer; of a negative relation between temperature variations and those of sunspots; and of a 180-year cycle and Bruckener's 35-year cycle. The possibility of these secular variations and of those of terrestrial magnetism being due to the same cause is suggested. C. A. S.

725. Variation of Soil Temperature below Turf. H. L. Wright. *Roy. Meteorolog. Soc., Mem.* 4. [18 *pp.*], *Oct.*, 1931.—The mean diurnal variations of air temperature and of earth temperatures at 10 and 20 cm. depth during 1927 at Kew (grass-covered loam) were respectively 4·81°, 2·07° and 0·83° C. The daily figures are harmonically analysed. The more rapid passage of heat from 10 to 20 cm. depth as compared with that from 0 to 10 cm. is attributed to the grassy covering of the soil, a view strengthened by comparison of the extrapolated " surface " temperature with that at Potsdam (bare sandy soil), where the surface temperature is a maximum 50 min. before, as against that at Kew being 40 min. after, that of the air. The range in sand is about twice that in loam, and a diurnal variation of at least 0·1° penetrates twice as deep in sand as in loam. Diffusivities for 10–20 cm. and 20–122 cm. depths in loam are respectively $4{\cdot}4 \times 10^{-3}$ and $6{\cdot}6 \times 10^{-3}$ cm.^{2} sec.$^{-1}$; in sand the figures are about double. C. A. S.

726. Stability of Temperature Reversals at Great Sea Depths. O. v. Schubert. *Gerlands Beitr. z. Geophys.* 31. 4. *pp.* 426–434, 1931.—Reference is made to the publications of Nansen, Schott, Schultz, Hesselberg and Sverdrup on temperatures at great sea depths. Hesselberg and Sverdrup concluded that for the Philippines and Bougainville regions labile equilibrium existed from 5000 m. downwards, but Wust concluded from Schott's values that neutral equilibrium existed in both regions. The author compares these results with those obtained by the " Snellius " expedition near the south end of the Philippines. Temperature was found to increase with depth, but the reversal occurs at 5000 m. instead of 3500 m. and the temperature increase was smaller and slower, giving 0·900° at 6530 m., whilst Schott gave 1·10° and Wust 0·9° at 4788 m.

This leads to a super-adiabatic temperature gradient in the region 4500–5500 m., while the water from 3500–10,000 m. exists, as Wust explained, practically in neutral equilibrium. The possible effects of change in salt content are discussed. Suppositions only can be made regarding the cause of the temperature increase, but heating of the bottom of the sea appears to be the ultimate cause. R. S. R.

727. Thermal Structure of Normal and Abnormal Months. E. Rubinstein. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 2.) **33.** *pp.* 305–312, 1931.—The author has extended the work of Ficker, using 40 points, mainly for the period 1881–1910, to get the correlation of the monthly mean temperature (t) and the interdiurnal variation (v) and the magnitude of the deviation from normal. For four places with longer series of observations, correlations for different periods show good agreement in different epochs. Charts of iso-correlation for the months Nov. to Apr. show that (1) for Nov. to Mar. in W. Russia there is an increased variation of temperature with lower values of t and the reverse for E. Russia, (2) the demarcation line moves from E. to W. in winter, (3) in Apr. the E. and W. regions show positive, and a central region negative, correlation and (4) the correlation varies over each region, and is a maximum on the coasts of the White and Barents Seas and at Jakutsk. The causes are traced to the stability of the Asiatic winter anticyclone and the varying effect of cyclonic disturbances. The results agree with those of Multanowsky. R. S. R.

728. World-Wide Oscillations of the Atmosphere. S. Chapman, S. K. Pramanik and J. Topping. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 2.) **33.** *pp.* 246–260, 1931. *In English.*—Oscillations of the atmosphere occur with solar and lunar periods of 24, 12, 8 and 6 hours. They affect both pressure and wind, but only the former is here considered. A formula is given depending on longitude, polar distance of the station and season. The causes, such as gravitational tidal forces in the air, variation of air temperature and vertical velocity of the under surface of the atmosphere are considered separately, and then a formula is given by Chapman for the proportionate isothermal variation of pressure in terms of the above causes and the free oscillation of the air. There seems to be a resonance effect in one of the components, which thereby fixes the equivalent height of the atmosphere. The resonance theory, however, is faced with serious difficulties, some of which have been discussed earlier. Experimenting at Batavia, it is found that lunar diurnal variation of temperature occurs adiabatically, so the difficulty of the atmospheric height still remains unsolved. Tables of amplitude and phase of 8-hourly temperature variations for stations in the N. and S. hemispheres are given. H. M. B.

729. Anemometer Diagrams. M. J. Holtzmann. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 2.) **33.** *pp.* 387–405, 1931.—To obtain the mean and maximum velocities and the degree of squalliness a special type of anemometer has been constructed which must acquire stability in 2–3 sec. during wind changes. A light Al vane is used and strengthened with a duralumin frame, while an electrical recording arrangement is used to get the velocity. Tests were made simultaneously at 2, 6 and 17 m. For a time, T, and variation, ϕ, of the momentary wind direction from the mean a relation is used $\beta = k\Sigma(\Delta\phi)/T$. The results lead to a relation $\beta = a\bar{V}^2e^{-kH}$, where $\bar{V}$ is the mean velocity in m./sec., for a height (H) in m., $a = 0{\cdot}00607$ and $k = 0{\cdot}067$. Extrapolation gives $\beta_{10}/\beta_{30} = 3{\cdot}8$ in comparison with Dines's value of 1·37. The author concludes that (1) β is a definite characteristic of the wind and as determinable as the mean speed, (2) the degree of squalliness for different directions depends on the surroundings, (3) the dependence of β on the mean wind velocity is definite but not so simple and (4) considerable deviations of β occur for the same direction and mean speed due to varying dynamic conditions of weather and atmosphere. The relations for different directions at the Observatory are given. R. S. R.

730. Theory of Turbulent Motion in the Atmosphere. E. L. Davies and O. G. Sutton. *Roy. Meteorolog. Soc., J.* 57. *pp.* 405–411, *Oct.*, 1931.—Existing theories are briefly discussed, and it is shown that none of these gives a satisfactory quantitative account of the processes occurring in the atmosphere, though describing the mechanism of eddies in distributing heat, etc., in the air. To deal adequately with eddy motion a theory is required which takes into account the variation of the motion with time, and this no existing theory does save the "Distance-neighbour graph" of Richardson. [See Abstract 1764 (1926).] C. A. S.

731. Wind Structure near the Ground and its Relation to Temperature Gradient. G. S. P. Heywood. *Roy. Meteorolog. Soc., J.* 57. *pp.* 433–452; *Disc.*, 452–455, *Oct.*, 1931.—Wind velocities at 13 m., v, and 94·5 m., V, and temperature gradients to 87 m. have been continuously recorded at Leafield from Aug., 1928, to July, 1930, and the results discussed and figured in detail. $(V-v)/V$ is practically constant, and the variation in monthly mean temperature gradient is small. The diurnal variation in wind velocity and gradient corresponds closely with that in temperature gradient, the wind gradient tending to constancy with moderately big inversions. Dividing winds into strong, moderate and light, the day maximum is less marked at a given height in light winds than in strong, and in winter than in summer. Gustiness is never great, and a factor of 0·1 and upwards only occurs when there is a lapse; its greater amount in winds that have blown over woods is clearly brought out. In the *Discussion*, results obtained at Cardington were described, showing no tendency for the wind gradient to become constant with moderately large inversions. C. A. S.

732. Primordial Atmosphere of the Earth. M. Milankovitch. *Gerlands Beitr. z. Geophys.* (*Köppen Band*, 2.) 33. *pp.* 219–222, 1931.—From the time when the surface of the primitive earth had cooled sufficiently (to about 1200°) for a solid crust to form until the lowest part of the atmosphere had reached the critical temperature of water, the atmosphere must have consisted chiefly of superheated water vapour. This would absorb practically all dark radiation from the earth, and be very little affected by solar radiation; it would also behave as a perfect gas, and the influence of other constituents of the atmosphere would be negligible. On these assumptions the temperature of such an atmosphere would fall at the rate of 1° per 188 m., and its mechanical equilibrium be indifferent. Assuming the total amount of water vapour equivalent to that of the water now on the surface of the earth, at the beginning of the epoch a temperature of 100° would be reached at 206·2 km., and of 0° at 225 km., between which heights a dense permanent layer of cloud would exist. C. A. S.

733. Probability of Multiple Periods in Meteorological Phenomena. A. Schmidt. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 2.) 33. *pp.* 40–44, 1931. *In Esperanto.*—Consideration of previous observations suggests that there exist certain normal conditions, *i.e.*, stationary states, in the general meteorological cycle, which correspond with definite values of the solar declination. A similar tendency is exhibited by the lunar cycle. Under certain conditions a closed cycle is produced of which the repetition produces periodic meteorological phenomena. H. F. G.

734. Discontinuities in the Course of Meteorological Phenomena. H. Arctowski. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 1.) 32. *pp.* 301–311, 1931. *In French.*—Several examples of the discontinuities in temperature/time and pressure/time curves are given, showing, *e.g.*, how the rise of temperature in spring proceeds not regularly, but with irregular drops of temperature. These are discussed, and certain connections between such variations at different places shown. C. A. S.

735. Meteorological Equator. O. Tetens. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 1.) 32. *pp.* 336–345, 1931.—The author refers to lines drawn on charts of isotherms which indicate for the year, or for various months, the line of highest temperature. Various expressions are considered by which the northerly and southerly character of a place may be considered. Using isothermal charts of Wild and Hann for Jan. and July, points are found for each 10° of latitude where the mean Jan. and July temperatures are the same and the breadth of an equatorial belt found. This has its maximum northerly value, 15°, at 60°–70° E. and maximum southerly value, 5°, at 110° and 320° E. It is affected by the distribution of land and sea. The results from Spitaler's figures are compared with those from Gorczynski and from *World Weather Records.* R. S. R.

736. Forecasting the Drift of Symmetrical Centres of High and Low Pressure. R. Bilancini. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 2.) 33. *pp.* 35–39, 1931. *In Italian.*—An equation has been developed for predicting the direction of movement of cyclonic or anticyclonic centres. Application of the equation to 44 centres of which the direction of movement had been observed showed that in 29 cases the divergence between the predicted and observed directions after 6, 11 and 24 hours was not more than 20° 30′; in 11 cases the divergence was between 22° 30′ and 45°; and in 4 cases either the result was doubtful or the divergence exceeded 45°. H. F. G.

737. Theory of Cyclones and Anticyclones. J. M. Angervo. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 2.) 33. *pp.* 45–59, 1931.—Mathematical. The equations $\alpha = -(p_{101}t + 0 \cdot 5p_{102}t^2)/(p_{200} + p_{201}t)$, and $\beta = -(p_{011}t + 0 \cdot 5p_{012}t^2)/(p_{020} + p_{021}t)$, previously deduced by the author are discussed in detail, and applied to the distribution of pressure over parts of Europe on three occasions. C. A. S.

738. Increase in Height Attainable by Sounding Balloons. E. Frankenberger. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 2.) 33. *pp.* 112–117, 1931.—A convenient method of testing the strength of the envelope is given. It is then shown that the atmospheric pressure at which the balloon will burst, provided that the weight of instruments is relatively small, is approximately proportional to the square root of the weight of the balloon. The theoretically most favourable amount of hydrogen is not the best in practice, as with it the balloon rises too slowly. [See also following Abstract.] C. A. S.

739. Ascent of Sounding Balloons. H. Hergesell. *Gerlands Beitr. z. Geophys.* (*Köppen Band*, 2.) 33. *pp.* 440–451, 1931.—Theoretically assuming the envelope gas tight, and the temperature of the contained gas to be always equal to that of the surrounding air, for every rubber balloon at a certain height the lifting force decreases, finally vanishing; but long before this height is reached the balloon bursts—when the balloon has expanded so that the thickness of envelope is about ·02–·01 mm., which is when pressure has fallen to about 20 mm. Further, theoretically the velocity of ascent should continually increase to a very considerable height, but actually it remains approximately constant, the discrepancy appears to be due to ignorance of the correct law of air resistance. The possibility of attaining a greater height by partial inflation of the balloon is discussed, but in such case the velocity of ascent is greatly diminished. Actual details for various makes of balloon are given. [See also preceding Abstract.] C. A. S.

740. Periodic and Non-Periodic Pressure Oscillations on Tropical Synchronous Pressure Charts. P. Heidke. *Gerlands Beitr. z. Geophys.* (*Köppen Band*, 2.) 33. *pp.* 186–218, 1931.—Values have been obtained for pressure tendencies at 1, 7, 13 and 19 hours G.M.T. for 16 stations, of which 11 are in the tropical zone, 5 at high and 6 at low levels. Normally the tendencies are positive at 1 and 13 hours and negative at 7 and 19 hours. The frequency of tendencies with anomalous signs and their magnitudes are shown to decrease equatorwards, and seldom occur in tropical zones. They occur also much less frequently at low levels. In a table are set out the mean periodic and non-periodic pressure changes and their ratios. The periodic oscillation increases and the non-periodic decreases equatorwards, the former becoming ten times as great in the inner tropical zone. The change is greater in the northern hemisphere because of the larger amount of land. The regular pressure oscillation in the tropics has no relation to the weather, and to get the relation of the pressure distribution to the weather this effect must be eliminated.

R. S. R.

741. Periodicity of Air-Pressure. K. Stumpff. *Gerlands Beitr. z. Geophys.* (*Köppen Band*, 1.) 32. *pp.* 379–411, 1931.—By methods previously described [see Abstract 81 (1930)] Fourier terms of the 6th to 25th orders are deduced from 34 barometric curves for places in Europe for the year July, 1925–June, 1926. Synoptic charts are given for the 6th to 23rd orders. These are discussed and classified into five types. A more detailed examination of the 20-day period over 5 years in consecutive intervals of 120 days is then made with diagrams enabling a survey of the variations of the 20-day wave to be made. Proposals for systematic work on these lines follow with a view to long period forecasting. C. A. S.

742. Humidity Measurements in the Slip Stream of Flying Aircraft. D. C. Rose. *Canad. J. of Research*, 5. *pp.* 482–489, *Oct.*, 1931.—This paper is a report on some experimental work on hair hygrometers and the wet and dry bulb thermometer type of hygrometer used in aircraft work. The results of preliminary observations using such instruments are given, the results indicating that hair hygrometers are not satisfactory. The findings obtained can be correlated easily with the weather conditions under which the flights were taken. AUTHOR.

743. Usefulness of Long-Period Rainfall Observations for a Given Area. E. Mathias. *Comptes Rendus*, 193. *pp.* 623–626, *Oct.* 19, 1931.—Rainfall data for Ambert from 1872 to 1930 show in 4-year periods a 15 % drop in 1917–1921 compared with the mean of the nine previous periods, and a reduction to 9 % in 1922–1926. The summit of Puy-de-Dome for the years 1877–1930 shows an increase to 1912–1916, then a rapid decrease to a minimum in 1920–1924 and subsequently an increase. The fluctuations are attributed to the great deforestation during the war and a subsequent increase of the wooded area by replanting. The effect is shown by both stations, although 100 km. distant and at a difference in altitude of 900 m. R. S. R.

744. Crystallisation of Water Vapour from the Air. G. Stüve. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 1.) 32. *pp.* 326–335, 1931.—Details are given of the various forms of rime when formed on different kinds of leaves, and the different types of crystals in snow and rime are illustrated. For the various nuclei serving for condensation it is concluded that (1) hygroscopic gaseous nuclei produce drops only, (2) soluble salts produce drops when condensation begins for temperatures above − 20° C. but star-shaped crystals when below − 20° C. and (3) non-soluble salts produce needles of ice at every temperature below 0° C. R. S. R.

745. Evidence for Increasing Dryness of the Earth. W. Halbfass. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 1.) 32. *pp.* 173–191, 1931.—The author deals first with the wide regions of Asia, Africa and Australia which have become appreciably drier in historic times as evidenced by decreased habitation and fall of water levels of river sources and seas. Among factors affecting this increased dryness are changes of precipitation, flow of water, evaporation, drainage, porosity of soil, tillage and changes in wooded areas. These factors are considered first in their application to increasingly arid zones of Central Asia, Palestine, Kenya, parts of N. Africa and S. Africa and the Kalahari Desert, but he considers it is not due to climatic changes so much as to one or more of the other factors. The relations are then applied to humid regions of the earth, and especially to Germany. Evidence exists of changes in the level of lakes and of river sources. The effects of land drainage in increasing the outflow of water, of changes in river bed levels to improve navigation, of tillage, of habitation in changing the porosity of the soil, use of water for drinking and other purposes are of most importance, and must be considered in their effects on the run-off of water from lands and the consequent increased dryness of the earth. R. S. R.

746. Gulf Stream and Weather. J. W. Sandström. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 1.) 32. *pp.* 254–259, 1931.—The author details the changes resulting from an observed excess of temperature of 5° in the Gulf Stream near Florida in the summer 1928. Six months later the warm water lay off S. Iceland with low pressure in this area and cold winds with much ice in Scandinavia. As the warm water spread to the Icelandic area, and in the winter of 1929 to the area Iceland, Spitzbergen, N. Norway, the low-pressure area moved north-eastwards, and warm S.W. winds with mild weather covered Scandinavia. Colder water travelled from the Faroes in 1930 and caused the cold spring of 1931. The author considers that detailed observations of the Gulf Stream could be used to forecast the general character of the weather some months ahead by analogy with previous similar cases. R. S. R.

747. Problem of the Gulf Stream. V. W. Ekman. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 2.) 33. *pp.* 353–364, 1931.—Former views regarding the drift and causes of the Gulf Stream as stated by Franklin, Maury, Meyer, Helland-Hansen and Nansen are first considered. For the region 30°–40° W. and 48°–50° N. the eastward motion of the water is considerable. South of this region the warm water at high levels and north of it the cold water at low levels, have little motion, while the water between is falling and on account of the earth's rotation acquires an acceleration to the right. In Sandström's view the stratification of the water is set up against the disturbance caused by the wind. The author investigates the possible density distribution at different depths across the current, and the resulting north or south motion set up at different depths by various winds. A value is then obtained for the tangential pressure on any layer, and this value compared with that necessary to counteract the northward motion of the current. No definite conclusions can be drawn, and further investigations over the whole region 20°–60° N., and for different directions from the Sargasso Sea, are required. R. S. R.

748. Observations of a Waterspout. A. Wigand. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 1.) 32. *pp.* 434–436, 1931.—Particulars are given of very unusual changes in the appearance of a waterspout off Mallorca. The initial pendant developed a transparent core, followed by a second pendant projecting downwards from this core, this in turn becoming transparent at the centre. The inner pendant then lengthened and became uniformly opaque, and the outer part of the original pendant contracted upwards towards the cloud. Finally, the inner pendant was detached from the cloud. R. S. R.

749. Great Dust Storm of April, 1928, in S.E. Europe. E. Stenz. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 2.) 33. *pp.* 313–337, 1931.—A dust storm from the east with wind velocity up to 20–30 m./sec. occurred over an area of some 200 × 400 km. in the Ukraine and surrounding regions during April 25–26, 1928. It resulted in places in removal of soil to a depth of 12 cm., and the deposit of dust elsewhere to a depth of 20–25 cm. During the following four days dust was deposited over some 74,000 km.^{2} in Rumania, and 116,200 km.^{2} in Poland, while dust in the air was observed in Czechoslovakia and Eastern Germany, the particles being finer and less dense as the distance westward increased. The dust travelled at a rate of about 37 km./hr. in the Ukraine, 30 in Poland, and more slowly farther west; it attained a height of 750 m. in the Ukraine, and 400 m. at Lwow, the time of fall of particles at different places agreeing with these figures. It is estimated that some 10^9 tons of soil were removed in the Ukraine, 2 million tons deposited in Rumania and 1·5 million in Poland. C. A. S.

750. Mechanics of Mountains. H. Jeffreys. *Geolog. Mag.* 68. *pp.* 435–442, *Oct.,* 1931.—Consideration is given to the crustal shortening involved in the formation of great mountain ranges. This is stated to occur in regions of unusually heavy sedimentation, this giving rise to an increase of heat and a weakening of the crustal layers. The cold superficial rocks yield by fracture, and the overlying heated sedimentary rocks by continuous adjustment. The crustal stress is relieved by crustal shortening. With an elevation > 3 km., fracture or flow occurs, and rocks spread over the surrounding country to form nappes. With the slow flow of rocks, the sediments at the centre become thinner, and finally a central massif of granite is left. R. S. R.

751. Volcanology. I. Friedländer. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 1). 32. *pp.* 113–133, 1931.—The paper gives a general survey of the outstanding problems of volcanology and of methods used to study the subject. W. A. R.

752. Continental Drift Force. H. Ertel. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 1.) 32. *pp.* 38–46, 1931.—A new formula for the equatorial force of the Wegener-Köppen theory is derived. Epstein's formula, which it replaces, suffered from a mistaken treatment of the gravitational potential. W. A. R.

753. Experimental Investigation of Vortices. J. Letzmann. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 2.) 33. *pp.* 130–172, 1931.—Since the introduction of energy to higher levels plays an important part in geophysical vortices, the author carried out experiments to find how a vertical current alters the field of motion of such vortex models and to ascertain the procedure in the transport of energy. A rotating disc was used to create the vortex and the resultant motion of the air rendered visible by passing steam, or in a few cases NH_4Cl vapour, into it. Various forms and shapes for the vortices are obtained by having cylindrical or conical shaped vessels projecting into the moving air column, the vessels having different dimensions, and being fixed at varying distances from the disc. Plates illustrate the several types of vortices—stable, unstable, hollow tube and conical leaf—the shape of the foot and the dissolution of the vortex. Diagrams illustrate the air motion of the several parts, in and near to the vortex, and the special conditions necessary to obtain each are discussed. The kinematic and dynamic conditions of the vortex and its relations of form and individuality show such a large agreement with the whirlwind and waterspout that they are considered identical. Three preliminary conditions are required: (1) general vorticity, (2) maximum possible convective acceleration of the vertical current and (3) a central action. Of the three essential parts—core, mantle and intermediate layer—it is shown that the last is most important. The mechanical theory involving frictional phenomena is shown to be insufficient. [See Abstract 2755 (1930).] R. S. R.

754. Determination of the Geoid by Means of Gravity Values. F. Hopfner. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 1.) 32. *pp.* 412–417, 1931.—The acceleration due to gravity at points on Rudzki's ellipsoid of revolution is determined, and thence by means of Bruns' and Rudzki's inversion theorems the deviation of the geoid from the ellipsoid, and in this way the geoid itself. C. A. S.

755. Application of the Free-Air Reduction of Gravity. H. Jeffreys. *Gerlands Beitr. z. Geophys.* 31. 4. *pp.* 378–386, 1931. *In English.*—It is shown that the application of the theorem of Green's equivalent stratum to the earth's gravitational field leads easily to an expression of the field in terms of that due to a certain distribution of mass over the geoid, which possesses complete first order accuracy. The free air reduction

of gravity is fundamental in this treatment. From this result a new derivation of Stokes' expression of the elevation of the geoid is obtained.
AUTHOR.

756. Wandering of the Pole. W. Jardetzky. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 1.) 32. *pp.* 361–367, 1931.—The problem of the wandering of the pole is considered in relation not to a fixed crust, as in classical theory, but to a crust over which continents are considered, according to the Wegener hypothesis, as drifting on a viscous substratum.
W. A. R.

757. Conceptions Regarding the Earth's Axis. A. Bilimović. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 2.) 33. *pp.* 181–185, 1931.—The earth must be considered as a variable system, and the rigid limits for an axis of rotation at a given instant which hold for an absolutely invariable system or a rigid body do not apply. The results of observation alone cannot solve the problem when taken over a short interval of time, while for long time intervals errors arise from continental displacement, formation and deep-seated changes. Four methods are reviewed by which relations regarding the earth's axis may be established: (1) geometrical method in which the figure of the earth is found, (2) geometry of mass in which the ellipsoid of inertia is found and its axis of rotation, (3) kinematic method and (4) dynamic method in which the velocity of the individual parts of the system and its mass are found. The method provides a means of analysing the earth's motion without any assumptions regarding the mass distribution or the real motion. R. S. R.

758. Electrical Resistivity of Underlying Beds. I. Roman. *Bureau of Mines, Techn. Paper* 502. [44 *pp.*], 1931.—Expressions are derived for the potential throughout space, when poles of known strength are placed within or on the boundary of a parallel plate. The simple geophysical case is studied in detail, and full tables are given to apply the method. W. A. R.

759. Seismic Prospecting. V. G. Gabriel. *Gerlands Beitr. z. Geophys., Angew. Geophys.* 2. 1. *pp.* 122–130, 1931. *In English.*—Seismic prospecting carried out in the Berggiesshübel (15–20 m. S.E. of Dresden) leads to the conclusions that the nature of the explosive used has no influence on the time-distance curves; the amplitude of the vertical motion is 1·5–2·5 times that of the horizontal; dropping a heavy weight, *e.g.*, 200 lb. of lead, may replace an explosive for short distances, *e.g.*, up to 100 m., but can only do so when the search is for shallow deposits; charts of sound velocity in air are unreliable for the computation of long-distance shots. The results are illustrated by numerous tables and charts. C. A. S.

760. New Observations of Wave PL. O. Somville. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 2.) 33. *pp.* 31–34, 1931. *In French.*—PL waves have been identified in seismograms of four recent earthquakes in S.E. Europe, recorded at Uccle, Eskdalemuir or Kučino by means of similar horizontal-pendulum Galitzin instruments. The time of propagation in these cases is regularly greater, T = 30–36 sec., than that of PL waves recorded similarly for earthquakes occurring in the North Atlantic, T = 26–31 sec. C. A. S.

761. Repulsive Forces in Solar Prominences. N. T. Bobrovnikoff. *Astrophys. J.* 74, *pp.* 157–187, *Oct.,* 1931.—Calculates the radial acceleration of prominences from observed heights at different times. In some cases the motion indicates a constant acceleration, or two or more constant accelerations acting successively; in others there seem to be impulsive changes of velocity with little or no acceleration in the intervals. Of thirty prominences examined, seven are in the latter class. In the other cases the total upward forces were usually less than 1·1 times gravitation, but values of more than twice gravitation occur. Both for hydrogen and for ionised calcium there is a tendency for the acceleration to increase with increasing distance from the sun's surface, and a correlation (in the case of Ca^+ very close) between velocity and acceleration. This is in fair numerical agreement with the theory developed by Milne and others. The impulsive changes of velocity occur without discoverable cause in the underlying photosphere, and are ascribed to explosions in the prominence itself. R. d'E. A.

762. Terrestrial and Solar Coronæ and their Relation to Cosmic Phenomena. L. Vegard. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 1.) **32.** *pp.* **288–300, 1931.**—The presence of nitrogen in measurable amounts at 800 km. shows that this gas must decrease in density much less rapidly than according to the laws for neutral gases. The author considers the layers are ionised by photoelectrons with the upper layers positive. The photoelectrons travel to a certain height and form an electronic cloud, especially on the side of the earth towards the sun. From the space charge a pressure and density distribution result. At great heights static equilibrium no longer results, and by collision or neutralisation the ions return. The material amounts and density distribution change from place to place, and have periodic changes. Sufficient material is present in the upper layers to explain the illumination of meteors at heights above 80 km., and Lindemann's and Dobson's high temperatures are not required, high ionisation and space charge being sufficient. The earth's corona is more extensive on the day than on the night side, and increases equatorwards. The zodiacal light and afterglow can be thus explained. The views support those of Millikan, but the latter stressed the importance of penetrating radiation to a small extent. The same photoelectric action is shown to hold for the solar corona, but with greater electronic velocity, the corona is more extensive and stronger than for the earth, while penetrating radiation is more important. Variations in the velocity explain increases of coronal intensity in years of maximum solar activity and its variation over the sun. The stream of electrified particles from the earth is deviated by the earth's magnetic field only if one kind of charge is in excess, and this is taken to explain the large angular distance between the aurora and its pole. The outer layer of the material of a comet is supposed charged by photoelectric action, positive charges are mutually repelled and give rise to the corona and core of the comet. R. S. R.

763. Sunspot Frequencies. M. Omschansky. *Gerlands Beitr. z. Geophys.* (*Köppen Band,* 2.) **33.** *pp.* **429–438, 1931.**—Wolf's series of sunspot numbers (continued by Wolfer and now by Brunner) shows that the small variations in frequency from month to month have a distinctly greater amplitude at times of sunspot maxima than at minima. But when analysed, and presented on a different scale, these small variations appear as all equal. The result agrees with Luby's hypothesis, that the small rapid changes are due to the action on the sun of the inner planets, while the large slow variation of the eleven-year cycle is due to the outer planets, and chiefly to Jupiter. The paper is mathematical. M. A. E.

764. Spectrum of Eclipsed Moon of Sept. 26, 1931. J. Dufay. *Comptes Rendus,* 193. *pp.* 711–714, *Oct.* 26, 1931.—In passing through the earth's shadow the moon is illuminated only by rays refracted by the earth's atmosphere, allowing us to see the effects of selective absorption and diffusion in shells that cannot usually be observed. In this case the author has studied the spectrum of regions nearer the centre of the shadow than has hitherto been done; and has obtained numerical results for the distribution of energy in these regions. The instrument, plates and method are described. The spectrum, in totality, extended from 5425 to 7040 Å. (about), but was weak from 5425 to 6030 Å., there was no trace of blue; the bands observed were 6867 Å. (B of oxygen), very marked, 6460 Å. (unidentified, but probably telluric), 6305 Å. (A of oxygen) and two bands at 6100 and 6200 Å. which were too weak for measurement. The ratio of spectral brightness of in to out of eclipse increases rapidly from 6305 to 6680 Å., and its value in the region is nearly double that where the wave-length increases by 200 Å.; beyond the ratio slowly increases. In the blue and violet regions the distribution of energy is the same as the sky spectrum near the uneclipsed moon. The impression beyond 5000 Å. may be attributed to diffused light from the moon emerged from eclipse. The numerical values of the ratio between 5500 and 6900 Å., after allowing for the diffused light effect, are uncertain, and show a large enfeeblement coinciding with the region of maximum absorption by atmospheric ozone. A. S. D. M.

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765. Astronomical Conditions in the Balearic Islands. K. Graff. *Akad. Wiss. Wien, Ber.* 140. 2*a*. 7. *pp.* 485–497, *and pp.* 513–518, 1931.—An expedition to these islands for three months in the winter 1930–1931, with astronomical equipment, in order to test the conditions, has proved that they are very superior to those of Central Europe; and an observatory erected here would probably give opportunities nearly as good as those of the great American observatories. M. A. E.

766. Photometric Observations of Eros at Majorca. K. Graff. *Akad. Wiss. Wien, Ber.* 140. 2*a*. 7. *pp.* 499–511, 1931.—In view of the variation in brightness of Eros, exceeding one magnitude, recorded in Vienna in Oct., 1930, a series of observations was made in Majorca from Dec. 12, 1930, to Feb. 7, 1931. Although the light-curves vary in form and amplitude, and also in epoch, there is sufficient regularity to admit the hypothesis of a rotating body, or two bodies revolving round one another, in a period of 2¼ hours. Measurements of colour, however, indicate a change, which, if confirmed, would require a different explanation. M. A. E.

767. Atmosphere of Venus. E. Schoenberg. *Preuss. Akad. Wiss. Berlin, Ber.* 21. *pp.* 383–416, 1931.—The surface of Venus is covered by an impenetrable atmosphere. Red filters reveal clearly the surface of Mars and deeper layers in the cloudy atmosphere of Jupiter; but with Venus only some faint and changing traces of detail appear with the ultra-violet filter. Investigations of the Doppler effect only tell us with certainty that the inclination of her axis to the ecliptic must be small and her rotation period long. A temperature of − 23° C. on the night side and about + 45° on the day side, estimated by radiometrical methods, tell us little without a knowledge of the composition and temperature gradients of the atmosphere, for we do not know to which layer the temperature applies. There is an almost complete absence of water vapour, and also of oxygen. Clouds therefore cannot cause the opacity. Photometrical measures of definite points on the disc, through five coloured filters, have now been made during four years, the aim being to determine the law of light distribution at all phases, under mean atmospheric conditions. The measures have been reduced on the principle of Rayleigh's diffusion theory for gases. The main results are: the albedo is 2·299; absorption is very small and without any increase for the red rays (due to absence of water-vapour and oxygen); and from the known value of horizontal refraction on Venus' surface, and the diffusion constant, the number of molecules per c.c. in her atmosphere is found to be 0·705 that of earth's atmosphere. A theoretical method of determining the temperature gradient of a planetary atmosphere by measuring the diameter through different filters is proposed. The "ultra-violet" diameter of Ross cannot be explained by thin clouds floating at great heights, but is more probably due to some kind of aurora. M. A. E.

768. Method of Correcting Distance Estimations in Double Star Observations. P. Salet. *Bull. Astronomique,* 6. 10. *pp.* 399–403, 1930.—It is common to count that personal equation is eliminated if a mean is taken of measures by all observers, but this cannot hold good since for instruments of different powers a single observer has differing personal equations. The author rules out, for reasons previously given, artificial comparison stars, and suggests the method of observing with the finder a test pair of stars (comparable in relative magnitudes and colours to the binary under consideration) which, by means of diaphragms, may give the same apparent separation in the finder as the binary itself presents in the telescope. If, for example, the original pair has a separation of 0″·4, and in the finder a couple of 4″·0 separation appears reduced to a tenth, this will give a comparable separation. The author discusses the details and concludes that this method will prove of importance not only to experienced observers, but also to beginners in this class of observation. He gives a warning that psychological influences must be avoided. A. S. D. M.

769. Classification by Shape of Extra-Galactic Nebulæ. Coma-Virgo Cluster. A. Machiels. *Bull. Astronomique,* 6. 10. *pp.* 405–416, 1930.—The author scrutinises the Harvard Catalogue of 2775 nebulæ in the Coma-Virgo cluster. There is an apparent deficit of objects completely spherical according to Hubble, and Mineur has deduced from this the existence of privileged orientation of the equatorial planes. If, on the contrary, the orientation is haphazard, we can assume a stage in the evolution of the cluster: advance-guard, 214 spirals; nebulæ in bulk, 2561 ellipticals more or less flattened; no rear-guard. The conclusion to be drawn, however, is that the elliptic nebulæ are wrongly spaced in their classes, seeing that an attempt is made to define 10 degrees of flattening by means of 10 points when only 9 degrees can be so defined. In the case of the spiral nebulæ a purely photographic effect comes into action, for in the case of small faint diameters the luminosity of the nucleus overlaps that of the arms. A. S. D. M.

770. Objective Prism Radial Velocities. P. M. Millman. *Roy. Astron. Soc. Canada, J.* 25. *pp.* 281–293, *Sept.,* 1931.—Even a partially complete survey of the velocity determination of fainter stars ($9\cdot0^{m}$–$11\cdot0^{m}$), is far too time-consuming, and yet radial velocities of faint stars are statistically very important for many researches. When used statistically, radial velocities need not have probable errors less than the mean random motions of the stars considered. The objective prism is accounted the most useful instrument for the purpose, and four methods are treated: (1) the use of standard bands given by an absorbing medium; here the best absorption afforded is by an aqueous solution of neodymium chloride giving a sharp band at λ 4272·90, width only 3 Å.; (2) use of the relative displacement of two mutually reversed spectra; (3) measurement of change in length of spectrum; and (4) miscellaneous methods. Of these suggested methods, actual measures have been published for three—for the Pickering reversion method (by Schwarzschild), the neodymium absorption method (by Schwarzschild and by Millman), and the length of spectrum method (by J. S. Plaskett). The author summarises in a table the velocity measures in km./sec., and compares the average deviation of the objective prism radial velocities with those from the slit spectrograph, which proves to be larger than was expected. In general the brighter stars have smaller probable errors and the correlation of probable error with effective dispersion is rather definite. The author suggests that a telescope should be designed specially for the velocities of faint stars, adaptable to all three methods, though the neodymium chloride absorption method gives least systematic error. A. S. D. M.

771. White Dwarfs and the Electrostatic Correction. D. S. Kothari. *Phil. Mag.* 12. *pp.* 665–676, *Sept.*, 1931.—In the theory of white dwarfs of degenerate gas at zero temperature, the effect of electrostatic potential energy has been neglected. By taking it into account it can be shown that the limiting mass of these stars is reduced by about 10 %, and the density is increased by 50 %. G. C. McV.

772. Beyond the Milky Way. J. Jeans. *Nature*, 128. *pp.* 825–832, *Nov.* 14, 1931. *Supplement. Paper read before the British Assoc., London, Sept.*, 1931.—Extra-galactic nebulæ (seen otherwise than edge-on) can be arranged in a single continuous sequence, such as in the evolution of a mass of rotating and shrinking gas. The differences in size and brightness between nebulæ of the same shape are mostly due to distance effect, and the members seem spaced fairly uniformly at about 1,800,000 light years apart; this spacing the author attributes to their origin from the primeval gas throughout space. He points out that there is a general breaking up process in the universe, the reverse of that shown by the attractive forces of gravitation, as shown in the radiation of mass from sun and stars, with loss of gravitational force (for example) by the sun on its system. A similar scattering is evidenced by the great extra-galactic nebulæ, and here the speed of recession from our Milky Way and from each other is, in general, approximately proportionate to distance, so that the universe expands at a speed that doubles itself every 1400 million years. This is accordant with the theory of relativity, and Eddington points out that the universe must have started from a radius of 1200 million light years, and has now attained to about eleven times its initial value. Therefore (the author points out) the universe must be at the beginning of its career, being no older than 10,000 million years at most. But this is in direct conflict with the ages of astronomical bodies, as the stars carry intrinsic evidence of having lived through far longer periods than this. He concludes that it is difficult to believe that the universe can be so ephemeral as is indicated by the apparent speeds of recession. A. S. D. M.

773. Configuration of Stellar Masses. E. A. Milne. *Observatory*, 54. *pp.* 243–251, *Sept.*, 1931.—The author shortly expounds the principles at the basis of his recent work on stellar structure [see Abstract 1140 (1931)]. He then discusses the model consisting of an outer perfect-gas envelope and an inner core of degenerate gas, the opacities in the two regions being unequal. He states the conditions which allow of the solution in the core being of Emden type, when the solution in the envelope is of collapsed, centrally-condensed or Emden type respectively. A criticism, based on potential energy considerations, recently brought forward by Eddington [see Abstract 2626 (1931)] is then dealt with by a demonstration that the index employed by Eddington does not coincide with the true polytropic index of any one of the regions in a composite configuration unless the opacity is assumed constant throughout the model. G. C. McV.

774. New Colorimeter for Stellar Measures. K. Graff. *Akad. Wiss. Wien, Ber.* 140. *2a.* 7. *pp.* 481–484, 1931.—Red or blue wedges in front of the real or the artificial star have been used for estimating star colours, but in this new form of instrument the light from the artificial star passes through a double wedge of blue and of red, constructed of specially selected glass, and the wedge scale is read with the help of a somewhat faint green light. The instrument is used with the 68-cm. refractor of Vienna Observatory, and has been found very satisfactory. Stars of all spectral types, from P to N, were measured, and interesting conclusions result concerning the relation between colour and spectral class. The O and early B stars have a colour resembling that of F5 stars; otherwise there is a direct relation of increasing redness from P to N, indicated by a difference in scale measurement of 30 mm. One exceptional star, a well-known red nebulous star of type O, resembles an M star in colour. The new colorimeter will be very valuable for studying stars of abnormal colour, and for following the colour changes of long period variables. Mira stars would show a difference of 20 mm. on the scale at extreme phases. M. A. E.

775. Visual Measures of Planetary Colours. K. Graff. *Akad. Wiss. Wien, Ber.* 140. *2a.* 7. *pp.* 519–520, 1931.—The colour of the planets is due to sunlight and the selective absorption of each planetary atmosphere, and these colours have been determined photographically. In January and February, 1931, visual observations were made in Majorca with the new Vienna colorimeter [see preceding Abstract], and the colours were compared with stellar spectral types. Every type is represented from B to K. The colours of Mercury, Venus, Jupiter, and Saturn agree with the photographic colour-index, but Mars is visually much redder and Uranus very much bluer. M. A. E.

776. Frequency of Stellar Colours. E. Öpik. *Harvard Coll. Obs., Bull No.* 885. *pp.* 1–8 *Oct.* 1, 1931.—The author discusses the findings by Halm and Schicker that the colour indices of stars are grouped closely round a few preferential colours, and concludes that little or no reality can be attributed to them since at least one of the preferential colours may be chosen absolutely; " the only real things are the pronounced maxima in the observed curve." He objects also that there is no reason to suppose that the spread round the preferential values is the same for all colours, or that gaussian spread is the right form. Especially the data must be freed from observational error dispersion. The author himself gives the colour frequency curve for 3186 Göttingen actinometric stars where the correction for error dispersion is made by successive approximations; this curve shows several pronounced maxima and minima, and he concludes that the preferential colours may be directly observable granted that the colour indices are of sufficient individual accuracy. Preferential colours do exist, but there is no possibility of abrupt " jumps " from one effective temperature to another as suggested by Halm, for the existence of all kinds of intermediate colours is well established. A. S. D. M.

777. Spectrohelioscope and its Work. Part IV. Methods of Recording Observations. G. E. Hale. *Mt. Wilson Observat. Contrib. No.* 434. *Astrophys. J.* 74. *pp.* 214–222, *Oct.*, 1931.—A summary statement of methods of recording observations with the spectrohelioscope and of calibrating the circle of its " line-shifter " is given. A photographic attachment is also described. [See also Abstract 4126 (1931).] AUTHOR.

778. Mean Light-Curves of Long-Period Variable Stars. Part IV. T Cephei. A. A. Nijland. *K. Akad, Amsterdam, Proc.* 34. 7. *pp.* 941–947, 1931. *In German.*—This star has a maximum of $5^{m}\cdot84$ and a minimum of $10^{m}\cdot12$, with a period of 390 days. Like T Cassiopeiæ, it appears to undergo a darkening on the rise towards maximum, which produces a hump on a curve which would otherwise be symmetrical. M. A. E.

779. Intensities of Balmer Emission Lines in Stellar Spectra. O. Struve and H. F. Schwede. *Phys. Rev.* 38. *pp.* 1195–1204, *Sept.*, 1931.—Contours of the Balmer emission lines in the spectra of fourteen stars of spectral class B*e* have been measured on twenty-seven spectrograms. In many stars the lines are broad and flat-topped, with steep outer edges, while in others they are double. The contours are explained by Doppler effect caused by the rotation of a nebula surrounding the star. The mean relative total intensities are: $\beta:\gamma:\delta:\epsilon = 10:6\cdot2:5\cdot2:(5\cdot4)$. The slow decrement in intensity agrees with the hypothesis that the bright lines are caused mostly by recombination. Lines produced in this way must be strongest (other things being equal) in a medium containing a maximum number of atoms of the next stage of ionisation. This agrees with the observed strength of the emission lines of Fe II and of H in the earlier subdivisions of spectral class B [see Abstract 2215 (1931)]. AUTHORS.

780. Total Absorption of Hydrogen Lines in Stellar Spectra. C. T. Elvey and P. C. Keenan. *Astrophys. J.* 74. *pp.* 223–224, *Oct.*, 1931. —An interim report on photographic photometry of the first four Balmer lines in sixteen stars of spectral types from B2 to A5, together with two K0 stars. One star (A0p) seems to show a marked variation in the total absorption of H_{α}. R. d'E. A.

781. Orbital Elements of Four Spectroscopic Binaries. H.D. 73619, 75767, 206546 and 214686. R. F. Sanford. *Mt. Wilson Observat. Contrib. No.* 433. *Astrophys. J.* 74. *pp.* 201–213, *Oct.*, 1931.—Only the first of these stars had previously been announced as a binary. In three cases both spectra are closely alike in intensity and type; in the fourth there is no secondary visible. Two of the eccentricities are fairly large. Velocity-diagrams are given in all four cases. R. d'E. A.

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782. Coloured Hydrocarbons: A Violet Hydrocarbon $C_{36}H_{22}$. C. Dufraisse and M. Badoche. *Comptes Rendus,* 193. *pp.* 529–531, *Oct.* 5, 1931.—This work followed from the authors' researches on a substance provisionally called "dephenylorubrene." They had occasion to prepare a hydrocarbon $C_{36}H_{22}$ having a magnificent violet colour. The methods of preparation are given. The results of absorption spectra investigations are also given and a possible structure for the hydrocarbon molecule is suggested to explain its colour. J. K.

783. Constitution of Solutions Deduced from Measurements of Absorption. P. Vaillant. *Comptes Rendus,* 193. *pp.* 654–656, *Oct.* 19, 1931.—The proposition—if x and y are the extinction coefficients for two fixed wave-lengths, the curve $y = f(x)$ joining the points representing a series of solutions containing a mixture of varying proportions of two absorbing elements is a straight line—is verified by measurements on solutions of mixtures of $CoCl_2$ and colourless chlorides. The measurements could not be used to establish a second proposition: that for three given solutions containing mixtures of various proportions of two absorbing elements, if x, y, z are their extinction coefficients for a single wave-length, the curve $z - x = f(y - x)$ is a straight line. C. B. A.

784. Changes in Absorption of Nitrogen Peroxide Produced by a Magnetic Field. P. Lambert and I. Agarbiceanu. *Comptes Rendus,* 193. *pp.* 732–733, *Oct.* 26, 1931.—The absorption of nitrogen-peroxide vapour in an intense magnetic field is observed. Certain changes occur, such as the appearance with the field of a line at 5880 Å., which is visible when the light vibrations are normal to the field but not when they are parallel. The experiments are being continued. C. B. A.

785. Transmission Factors of Coloured Signal Lenses. H. Buckley. *Optical Soc., Trans.* 32. 2. *pp.* 66–68; *Disc.,* 68. 1930–1931.—The paper gives a theoretical treatment of the problem of the determination of the transmission factors of coloured lenses such as are used for railway signalling purposes. AUTHOR.

786. Effect of Low Temperatures on the Ultra-Violet Transmission Band of Silver. J. C. McLennan, C. E. Smith and J. O. Wilhelm. *Phil. Mag.* 12. *pp.* 833–840, *Oct.,* 1931.—The ultra-violet transmission band of silver was photographed at the temperatures of liquid air, liquid hydrogen and liquid helium, and by means of microphotometer traces the positions of maximum intensity were obtained for these temperatures. The mean frequency of the transmitted band was found to be approximately inversely proportional to the absolute temperature for the temperatures considered. AUTHORS.

787. Measurements of Transmission through Sodium and Potassium Chlorides in the Region of their Infra-Red Characteristic Frequencies. R. B. Barnes and M. Czerny. *Zeits. f. Physik,* 72. 7–8. *pp.* 447–461, *Oct.* 28, 1931.—Films of sodium and potassium chlorides of the order of 1 μ in thickness have been prepared by condensing the vapours of the salts on thin celluloid membranes, and the percentage transmission through the films has been determined at wave-lengths between about 45–75 μ and 35–75 μ, respectively. The results yield the same optical constants as are obtained with thin plates of the salts prepared mechanically from large crystals. The principal frequency of sodium chloride is at $61 \cdot 1 \pm 0 \cdot 3\,\mu$, and that of potassium chloride at $70 \cdot 7 \pm 0 \cdot 3\,\mu$, and in addition to the bands at $40 \cdot 5\,\mu$ and 47 μ, respectively, less pronounced bands have been observed at 51 μ and 60 μ, respectively. The influence of interference-effects on measurements with very thin films is discussed, together with the extent to which the frequency at which the transmission is a minimum may be identified with the characteristic frequency of the material of which the film is composed. H. F. G.

788. Interrelation of Various Aspects of Colour Vision. S. Hecht. *J.O.S.A.* 21. *pp.* 615–639, *Oct.*, 1931.—In normal colour vision quantitative measurements are concerned with colour-mixture, luminosity, hue discrimination and saturation. Here, a single colour system is described which yields perfect agreement with some data and approximate agreement with others. Young's trireceptor hypothesis is taken as a basis of the theory and all the aspects of normal colour vision may be derived according to certain rules of computation from the spectral characteristics of the three primary receptor processes. H. M. B.

789. Ultra-Violet and Light Reflecting Properties of Aluminium. A. H. Taylor and J. D. Edwards. *J.O.S.A.* 21. *pp.* 677–684, *Oct.*, 1931—The paper is concerned with the reflecting power of etched aluminium such as is used for lighting fittings, etc. There are three important methods of etching, (1) by hydrofluoric acid, (2) by sodium hydroxide–sodium fluoride and (3) a combination of method (2) followed by method (1), and tests were made on samples etched by each method. The diffuse reflection factor was found to be about 85 % for light, and for ultra-violet a relative factor of about 118, based on 100 for magnesium carbonate, was obtained. It is concluded that, from general considerations including convenience of etching, the sodium hydroxide–sodium fluoride is probably the best. G. E. B.

790. Interpolation Formulæ for the Refractive Indices of Glass. (Mrs.) E. Gifford. *Optical Soc., Trans.* 32. 2. *pp.* 69–71; *Disc.*, 72, 1930–1931.—Formulæ for the refractive indices of glasses for five lines are given, making use only of the measured indices for the C, D and F lines of the spectrum. A particular feature of the formulae is the simplicity of the numerical coefficients which renders the calculations extremely easy and rapid. Particulars are given of the errors found in the application of the formulæ and numerical examples are included. AUTHOR.

791. Refractometric Value of Fluorine in Organic Compounds. G. Schiemann. *Zeits. f. phys. Chem.* 156. *Abt.A.* 5–6. *pp.* 397–418, *Oct.*, 1931.—On the basis of measurements of density and refractive indices of about 30 aromatic fluorine compounds, the atomic refraction and dispersion of fluorine are calculated. The values obtained give good results in the calculation of the molecular refractions of all aromatic and aliphatic compounds so far investigated. C. B. A.

792. Refractive Dispersion of Organic Compounds. Parts I, II and III. T. M. Lowry and C. B. Allsopp. *Roy. Soc., Proc.* 133. *pp.* 26–59, *Sept.* 1, 1931.—An interference method is developed by means of which the refractive indices of a thin film of liquid can be measured to four places of decimals over a range of wave-lengths from about 5000 Å. up to the limit of transparency of the film in the ultra-violet. The experimental arrangement is similar to that previously described [see Abstract 1810 (1930)]. Values for the refractive indices of highly-purified cyclohexane are given to four decimals for 21 wave-lengths in the visible, measured with a Pulfrich refractometer, and for 97 readings down to 2450 Å. by the photographic method. These indices can be expressed by a simple dispersion equation, but systematic deviations are found between 3950 and 2800 Å. Smaller deviations in the visual readings are attributed to instrumental errors in the refractometer, since they are not observed in the photographic readings, and are not shown in Gifford's hollow-prism measurements. Values of the refractive indices of benzene are given for 144 wave-lengths down to 2700 Å. In the visible, the Pulfrich refractometer readings are less accurate than Gifford's values, which, together with the new photographic data for the violet and ultra-violet, and those of Rubens for the infra-red, can be expressed by an equation containing one constant term and three variable terms corresponding to frequencies in the Schumann region, in the middle ultra-violet and in the infra-red, but concordant results are only obtained when a damping factor is introduced into the middle ultra-violet term. C. B. A.

793. Quantum Theory of Dispersion in Metallic Conductors. Part II. R. de L. Kronig. *Roy. Soc., Proc.* 133. *pp.* 255–265, *Sept.* 1, 1931.—As in Part I Bloch's theory of metallic conduction is employed [see Abstract 3258 (1929)]. The action of the other conduction electrons and the ions on a given conduction electron is replaced by a periodic field of potential. In this paper the optical behaviour of a metal is first considered, neglecting the collisions of the electrons with the lattice. Some points which were rather obscure in Part I are more fully explained. The spectrum of a particular electron is first considered. The other conduction electrons are distributed over the different stationary states according to the statistics of Dirac and Fermi, each electron having its own sequence of absorption lines, the frequencies varying slightly from electron to electron, so that the resultant absorption spectrum consists of bands. Every electron has also the frequency $\nu = 0$ as resonance frequency, so that there is a sharp spectral line at this frequency. This implies that the electrons can move freely through the lattice, when its deformation due to thermal agitation is neglected. The surface and volume photoelectric effects are also dealt with. The optical properties in the transitional region of the spectrum, which at ordinary temperatures extends from about $1 \cdot 5\,\mu$ onwards into the red, are then considered. In this region the influence of the optical absorption bands is already quite small, and it is neglected for this part of the spectrum, the metal being treated as if it had only the resonance frequency $\nu = 0$. It is shown that the optical properties here are markedly affected by the broadening which the $\nu = 0$ line undergoes, owing to the effect of collisions with the lattice due to thermal agitation. H. N. A.

794. Invariant Formulation of Dirac's Dispersion Theory. Part II. W. Wessel. *Zeits. f. Physik*, 72. 1–2. *pp.* 68–85, *Oct.* 5, 1931.—Continuing previous work [see Abstract 1800 (1931)] the author investigates whether a physical interpretation ought to be ascribed to certain " longitudinally-vibrating " quanta of the vector potential met with in his theory of the interaction of radiation and charges (electrons). He decides in the negative by reason of the non-invariance of the quantising of the field components concerned in a Lorentz transformation. In the theory the difficulty exists that in the expression for total energy the term for the mutual energy is infinite. This is not removed, but by rearranging the theory it is shown how the invariance of the self-energy of an electron may be preserved while the longitudinal components of the field are made to vanish. Two heuristic hypotheses are considered as a result of which the self-energy could be made to vanish, and also, in the problem of the free electron, the energy series of the electron could be made convergent when carried to a second and probably higher approximations. N. D.

795. Birefringence in Minerals. A. Debenedetti. *Accad. Lincei, Atti,* 14. *pp.* 134–138, *Aug.*, 1931.—Formulæ are derived for obtaining the maximum birefringence of a mineral from any chance section by employing Fedorow's universal stage. W. A. R.

796. Singular Optic Directions in Strongly Absorbing Crystals of Rhombic Symmetry. M. Berek. *Zeits. f. Krist.* 80. 1–2. *pp.* 18–36, *Sept.*, 1931.—Drude's general formula for calculating the positions of the singular optic directions—*Windungsachsen*—[see Abstract 547 (1903)] leads to an impracticable equation. An approximate solution for crystals of weak absorption and weak double refraction is given based on the positions of the polarisation and absorption axes. By means of equatorial and meridional coordinates an exact solution for strongly absorbing and strongly doubly-refracting rhombic crystals is arrived at, and illustrated by figures showing the six types of relative positions of the three sets of axes. These results are applied to stibnite for which the meridional and equatorial coordinates of the four singular optic directions are ± 56·4° and ± 2·7° respectively. The third principal index of refraction of stibnite, n_b^{Na}, is 3·41. C. A. S.

797. Optical Rotation of Lactic Acid. W. D. Bancroft and H. L. Davis. *J. Phys. Chem.* 35. *pp.* 2508–2529, *Sept.*, 1931.—Since the salts and esters of sarcolactic acid are laevo-, although its dilute aqueous solutions are dextro-rotatory, the acid is most properly designated as $l(+)$ lactic acid. Three forms have previously been described: a lactide (strongly laevo-), an anhydride (moderately laevo-) and the normal lactic acid (laevo-). The dextro-rotatory aqueous solutions are attributed, as for malic acid, to the existence of a fourth, dextro-rotatory ethylene oxide form, the solution containing all four in equilibrium. Equilibria involving the anhydride or lactic forms are reached very slowly, the normal and ethylene oxide forms very rapidly. The rotation of a rapidly-concentrated solution, on standing, may change from + 15° to − 21° as a result of the formation of anhydride. Freshly prepared, rapidly concentrated, sarcolactic acid, diluted sufficiently, shows laevo-rotation, but on standing, becomes increasingly dextro-rotatory as the anhydride slowly forms hydrate. With increasing concentration solutions in equilibrium will show increasing dextro-rotations as the proportion of ethylene oxide form increases, till the formation of anhydride forms becomes important, when the rotation passes through a maximum and becomes more laevo-rotatory. Confirmatory evidence is similar to that for malic acid. C. B. A.

798. Influence of Salts on the Optical Rotation of Gelatin. D. C. Carpenter and J. J. Kucera. *J. Phys. Chem.* 35, *pp.* 2637–2649, *Sept.*, 1931.—The influence of potassium salts on the optical rotation of potassium gelatinate at pH 6–7 is studied. The univalent salts fall into a Hofmeister series for their effectiveness in lowering the activity. The salts of weak acids have very little effect. The changes are ascribed to an equilibrium between "gel" and "sol" forms of the gelatin molecule. Reversible compound formation between potassium gelatinate and the added salt is not contrary to this view. [See also Abstract 885 (1928).] C. B. A

799. Quarter-Wave Plate for the Ultra-Violet. G. Bruhat and J. Thouvenin. *Comptes Rendus*, 193. *pp.* 727–729, *Oct.* 26, 1931.—The quarter-wave plate consists of two thin plates of quartz (thickness 107 μ), one right- and the other left-handed, cut perpendicular to the axis. When placed together at an angle to the incident light these act as a quarter-wave compensator for a wave-length depending on the angle of incidence. The theoretical relationship between these two quantities is tested experimentally and found to be satisfactorily verified. The system has the disadvantages of oblique incidence and a necessity for very exact alignment. The rotation produced by a plate of quartz cut perpendicular to the axis and inclined to the incident beam is shown to depend on the square of the cosine of the angle of inclination. C. B. A.

800. Theory of Electro-Optical Phenomena. Molecular Polarisation and Dissymmetry. R. de Mallemann. *Comptes Rendus*, 193. *pp.* 523–526, *Oct.* 5; 651–654, *Oct.* 19, and *pp.* 729–732, *Oct.* 26, 1931.—In the first of these three papers on molecular dissymmetry it is shown that when the molecule has at least two planes of symmetry, the molecular polarisation reduces to a single vector passing through a fixed point, for any direction of the field. This point does not necessarily coincide with the geometrical centre; it may be called the centre of polarisation of the molecule. When the molecule is asymmetric, the molecular polarisation reduces to a resultant and a couple, whose axis is parallel to the resultant. The molecular theory of polarisation is thus related to the geometry of systems of right lines. In particular, the importance of the tetrahedron from the point of view of optical activity is a consequence of Chasles' theorem, which expresses the automoment geometrically. These results are developed further in the second paper, and it is shown that the dissymmetry of a molecule can be defined quantitatively by the value of the automoment of polarisation. The optical dissymmetry of the molecule is measured by the value of the rotation automoment, and in the third paper the molecular dissymmetry is related to the rotatory power of the substance. The method of calculation of the dissymmetry is outlined. C. B. A.

801. Validity of Kerr Law for Nitrobenzene in Electrostatic Fields. F. Hehlgans. *Phys. Zeits.* 32. *pp.* 803–808, *Oct.* 15, 1931.—By means of visual and photographic determination of the path difference in a Kerr cell, using a Babinet or a Babinet-Soleil compensator, it is shown that for highly purified nitrobenzene Kerr's law of the dependence of path difference on the square of the field holds in electrostatic fields up to $1\cdot5 \times 10^5$V/cm. within experimental error (about 1 %). C. B. A.

802. Magnetic Rotation Spectrum and Heat of Dissociation of the Lithium Molecule. F. W. Loomis and R. E. Nusbaum. *Phys. Rev.* 38. *pp.* 1447–1457, *Oct.* 15, 1931.—The magnetic rotation spectrum of the green, $^1\Pi - {}^1\Sigma$, band system of Li_2 has been observed and used to locate bands with high quantum numbers and so to obtain an accurate value for the heat of dissociation of the normal Li_2 molecule, yielding $D_0'' = 1 \cdot 14 \pm 0 \cdot 03$ volts. The spectrum is less simple than in Na_2, for instance, in that we observe not only a strong line at the head of each band, but also a few lines of the P and R, but not Q, branches. An improved method of plotting Franck-Condon diagrams is illustrated.

AUTHORS.

803. Interference Phenomena in Lenticular Screen Films. G. Heymer. *Zeits. f. techn. Physik,* 12. 11*a*. *pp*. 578–582, 1931.—The Berthon film used in colour photography shows interesting interference phenomena which generally appear different from an ordinary grating effect. The main characteristics, a limited number of fringes of uniform intensity, can be explained by a simple optical investigation, which predicts the departure from the expected appearance. The intensity distribution and number of fringes are related to the shape of the lenses.

C. B. A.

804. High-Power Source of Continuous Ultra-Violet Spectrum. G. B. Kistiakowsky. *Rev. Sci. Instruments,* 2. *pp*. 549–550, *Sept*., 1931.—A new type of hydrogen discharge tube, as a source of continuous ultraviolet radiation, is described, possessing the advantages of extreme rigidity, long life and an almost unlimited power input. The spectrum obtained extends to below the transparency limit of the fused quartz of which the tube is constructed; water cooling is employed. A. H.

805. New Sodium Light Source of High Luminous Intensity. M. Reger. *Zeits. f. Instrumentenk.* 51. *pp*. 472–476, *Sept*., 1931.—The lamp consists of two electrodes in a glass envelope containing a rare gas and metallic Na. An outer glass tube protects the inner tube, and the space between is evacuated. In the a.c. type the current passes through a series resistance and both electrodes until a red glow is reached, when the full voltage is applied to the electrodes. The tube glows, giving the spectrum of the rare gas. Part of the Na is vaporised from the electrode, an intense yellow glow results, and in 2–3 min. the spectrum of the rare gas disappears. In the d.c. type the kathode only is the glowing electrode and the anode a tungsten sphere. The outer tube helps to get the Na to the desired temperature. The intensity of illumination is 20 times that of the Bunsen burner flame and can be varied. Filters may be used, if desired, to eliminate the red and green Na lines. The instrument is specially useful for polarisation apparatus, for detection of flaws and other irregularities and for other optical purposes. R. S. R.

806. Characteristics of the General Electric Photoflash Lamp. W. E. Forsythe and M. A. Easley. *J.O.S.A.* 21. *pp*. 685–689, *Oct*., 1931.—The photoflash lamp, which is intended for flashlight photography, consists of a bulb containing about 170 mm. of pure oxygen and about 600 sq. cm. of aluminium foil about 0·00004 cm. thick. The filament of the lamp is coated with a paste which ignites when the filament is heated, and so starts the foil burning. Lamps are made suitable for flashing on any voltage from about 3 to 120 volts. The flash takes place in one- or two-hundredths of a second after lighting the filament and gives a total output of 47,000 lumen-seconds, with a peak intensity 4½ million lumens. Spectral analysis of the illumination showed radiation down to 3000 Å., although the ultra-violet intensity was not very great. G. E. B.

V.3
193

807. Falling Plate Flashometer. W. E. Forsythe and M. A. Easley. *Rev. Sci. Instruments,* 2. *pp.* 638–643, *Oct.*, 1931.—The flashometer was designed to study the characteristics of the "photoflash" lamp [see preceding Abstract], which produces an instantaneous illumination of high actinic value. The light from the lamp falls on a falling photographic plate located behind a horizontal slit, a time scale being given by means of the focussed image of a carbon filament lamp, heated by alternating current, which lay in a magnetic field of suitable strength. Figures show that a typical photoflash lamp reaches an intensity of some 7×10^6 lumens, the duration of the flash being about 0·05 sec. G. E. B.

808. Construction and Operation of Capillary Mercury Arcs. R. H. Crist. *J.O.S.A.* 21. *pp.* 690–697, *Oct.*, 1931.—When a linear source of high intensity is required, a capillary arc is a practical convenience, but difficulties are encountered as a result of deposits formed in the capillary. At low temperatures a brownish deposit is formed, and at higher temperatures a white deposit appears. The paper describes a lamp designed to operate between these two temperatures, which uses a capillary having a bore of 3 mm., an outside diameter of 7 mm. and a length of 50 mm. The lamp functions on 90 volts, and passes 5·5 amperes. Curves illustrating the time-history of the 3650 line are given. G. E. B.

809. Self-Recording Spectrometer. H. M. Randall and J. Strong. *Rev. Sci. Instruments,* 2. *pp.* 585–599, *Oct.*, 1931.—The instrument described is a recording spectrometer for infra-red work as far as $20\,\mu$. It is intended for preliminary investigation of absorption of gases and can be provided with either a 30° prism, a combination of 30° and 60° prisms or with an echelette grating. The prisms usually used are of artificial KCl, KBr or KI. Examples are shown of NH_3 and CH_3I at various pressures. F. S.

810. Twenty-one Foot Vacuum Spectrograph for the Extreme Ultra-Violet. G. R. Harrison. *Rev. Sci. Instruments,* 2. *pp.* 606–610, *Oct.*, 1931.—The construction of a vacuum spectrograph containing a 6-in. concave speculum grating of 21 ft. radius of curvature is described. Exposures of the order of magnitude of 1 hr. suffice to give satisfactory spectrograms having a dispersion of 2·7 Å. per mm. in the first order, the entire range 2000–1000 Å. being recorded at one setting on a 16-in. plate. By means of a vacuum-tight screw, up to thirty exposures can be taken on a single plate, and introduction of a stop-cock in the slit tube allows source and slit to be changed at will. A gate is provided which allows air to be admitted to the 40 l. camera box without destroying the vacuum in the 830 l. body of the spectograph, to facilitate the changing of plates. By means of a Cenco Hypervac pump and three 4-stage Gaede diffusion pumps the instrument can be evacuated from atmospheric pressure to below 10^{-4} mm. in an hour or less. High resolving power has been obtained in hot spark spectra of the elements of the first long period, which should facilitate wave-length measurements on the spectra of ionised atoms; the main purpose of the instrument, however, is to enable intensity measurements to be made in the Schumann region. AUTHOR.

811. Measurement of Coma and Astigmatism by Means of Diffraction Fringes. Flora Villani. *N. Cimento,* 8. *pp.* 264–272, *July,* 1931.—Verifies experimentally the formulæ deduced by Scandone [see Abstract 3421 (1931)] for deriving the astigmatic aberrations and the coma from an examination of the shadow fringes. E. E. F. d'A.

812. Long-Focus Prism Spectrographs. R. Mannkopff. *Zeits. f. Physik*, 72. 9–10, *pp.* 569–577, *Oct.* 30, 1931.—Introduces a method for avoiding an inconveniently great overall length in the spectrograph, by introducing a totally reflecting prism into the path of the beam, with the result that the total deviation caused by the prisms is of the order of 180°, and the photographic plate is side by side with the entrance slit. There are separate collimator and camera lenses. The focal curve of spectrographs with one and two prisms, and simple lenses of the same material, has been calculated, and agrees with the observations made. The instrument, though not heavy, is stable, gives bright spectra and is free from reflexes. H. N. A.

813. Calculation of Fresnel Lenses. H. Schulz. *Zeits. f. techn. Physik*, 12. 11*a*. *pp.* 569–572, *and pp.* 573–574, 1931.—The formulæ necessary for the calculation of the zones of Fresnel lenses are determined for the case of equal thickness of the zones and of co-axial spherical surfaces. It is also found that the application of concentric spherical surfaces is possible. In the second paper, formulæ are given for the calculation of the zones and inner radii of lenses with curved outer surfaces. For a given curvature of the outer surfaces a lens with coaxial spherical inner surfaces is completely determined. The formulæ can be applied, with slight modification, to surfaces formed by rotation of conic sections. C. B. A.

814. Cracking of Projection Lenses. J. Flügge. *Zeits. f. techn. Physik*, 12. 11*a*. *pp.* 574–576, 1931.—Projection lenses crack less often on account of unequal cooling or of inhomogeneity than on account of damage to the lens rim which sets up strain on cooling, even when special heat-resisting glass is used. The resistance of the lens to heat is found to be improved by rounding and polishing the rim. (Patented.) C. B. A.

815. Universally Rotatable Object Table. M. Straumanis. *Zeits. f. techn. Physik*, 12. 11*a*. *pp.* 576–578, 1931.—A simple universally rotatable mounting, suitable for specimens in crystallographic or metallographic investigations, is described and some applications discussed. C. B. A.

816. Iowa Eye-Movement Camera. H. H. Jasper and R. Y. Walker. *Science*, 74. *pp.* 291–294, *Sept.* 18, 1931.—The camera is designed on the corneal reflection principle and has the following advantages: (1) simultaneous recording of binocular horizontal and vertical movements; (2) the production of positive record of sufficient magnitude for easy reading; (3) adaptable to various eye-movement problems; (4) low cost of construction and operation. H. M. B.

817. Photoelectric Spectrophotometer. R. Sewig, L. Bähr and A. Zincke. *Zeits. f. Instrumentenk.* 51. *pp.* 479–482, *Sept.*, 1931.—The monochromator used has constant deviation. Light passes through a slit to the photoelectric cell, and the current produced is registered by a quadrant electrometer, the motion of the needle being observed, after reflection, on a matt glass surface. The curve obtained has wave-lengths as abscissæ and photoelectric currents as ordinates, and the method can be used to obtain the distribution of spectral sensitivity of the photoelectric cell with an accuracy of ± 5 %. It can also be used to obtain the transmission of colour filters for 4000–7000 Å. R. S. R.

V.3
193

818. Compact Apparatus for Microphotography. F. Hauser. *Zeits. f. Instrumentenk.* 51. *pp.* 483–488, *Sept.*, 1931.—The optical bench type of camera for microphotography is cumbersome, and adjustment is not easy. This is overcome by using two mirrors at 90° to one another, so that the light from the microscope is reflected in turn at each mirror, and returns along a parallel path. This allows the microscope and the photographic plate to be beside one another at the same end of the instrument. The commercial instruments involving this principle are described in detail. A. C. M.

819. Method of Measuring the Integrated Light from Short Flashes of High Intensity. L. R. Koller. *Rev. Sci. Instruments*, 2. *pp.* 551–553, *Sept.*, 1931.—A description of a circuit employing a photoelectric cell and a thyratron for the measurement of the integrated light from flashes of high intensity, but of very short duration, such as are given by airport beacons. A. H.

820. Colorimeter for Use with Disc Mixture. D. Nickerson. *J.O.S.A.* 21. *pp.* 640–642, *Oct.*, 1931.—Description of an instrument designed to measure the colour of agricultural products; hay, cotton, vegetables and so forth. Diagrams show the method of procedure. The instrument can be adjusted to measure either small or large areas, or to give the average colour of a highly variegated surface. Results can be expressed as brilliance, hue and chroma. The instrument can be used simply as a photometer by the substitution of black and white discs. Liquids can also be tested. [See also following Abstract.] H. M. B.

821. Colour Measurements. D. Nickerson. *J.O.S.A.* 21. *pp.* 643–650, *Oct.*, 1931.—A method of describing colour with the exactitude of actual measurement is shown. A colour is divided into hue, brilliance and saturation, and given numerical significance. Several subjects have been tested, either using an instrument previously described [see preceding Abstract], or using colour discs spun on a top and in all tests the deviation from the mean was relatively small. The method is applied to agricultural products, such as hay, cotton and so forth. Figures are given in illustration. H. M. B.

822. Correlated Colour Temperature for Illuminants. R. Davis. *Bureau of Standards, J. of Research*, 7. *pp.* 659–681, *Oct.*, 1931.—As has long been known, most of the artificial and natural illuminants do not match exactly any one of the Planckian colours. Therefore, strictly speaking, they cannot be assigned a colour temperature. A colour of this type may, however, be correlated with a representative Planckian colour. The method of determining correlated colour temperature described in this paper consists in comparing the relative luminosities of each of the three primary red, green and blue components of the source with similar values for the Planckian series. With such a comparison three component temperatures are obtained; that is, the red component of the source corresponds with that of the Planckian radiator at one temperature, its green component with that of the Planckian radiator at a second temperature and its blue component with that of the Planckian radiator at a third temperature. The average of these three component temperatures is designated as the correlated colour temperature of the source. The mean deviation of the component temperatures from the average temperature is used as a basis for specifying the colour (chromaticity) departure of the

source from that of the Planckian radiator at the correlated colour temperature. The conjuctive wave-length indicates the kind of colour departure.
AUTHOR.

823. Departures from the Cosine Law of Emission in the Case of Incandescent Tungsten. E. Spiller. *Zeits. f. Physik*, 72. 3–4. *pp.* 215–217, *Oct.* 14, 1931.—It was found by Worthing that incandescent tungsten was not a perfectly diffuse emitter. The author describes a fresh determination of the variation of emission with angle. This variation depends on the state of the surface. A very clean surface gives a well-defined maximum emission at about 75°, the difference from the emission at 0° being about 18 %. For an oxidised surface the maximum is much less pronounced, and may even disappear altogether. J. W. T. W.

824. Four-Colour Additive Projection. A. B. Crow. *Phot. J.* 71. *pp.* 351–356, *Sept.*, 1931.—The experiments illustrate the working out of an optical system whereby (1) photographs representing four-colour sensations can be taken simultaneously and diapositives representing those four sensations can be projected in register so as to reproduce the natural colours, and (2) an analysis of the spectrum can be made by means of colour filters comprising a taking set. The novel point of the optical system consists in the use of a set of quadrant-shaped refracting prisms having their thin edges meeting in the principal axis of the lens. A. H.

825. Photographic Unit of Intensity. *J.O.S.A.* 21. *pp.* 654–676, *Oct.*, 1931.—A report of the O.S.A. committee on the photographic standard of intensity. § 1 deals with the recommendation of the seventh international congress of photography. § 2 contains a note on the approval given by the English and American committees and the Optical Society of America. § 3 discusses the use of pyridine in the recommended filter; it includes Calzavara's objections thereto, together with Luther's proposal of a copper-glycocoll solution and a special sub-section on the reproducibility of pyridine. § 4 discusses the use of mannite, and § 5 the use of cobalt ammonium sulphate in the recommended filter. § 6 details the recommendations to the eighth international congress of photography.
H. H. Ho.

826. Applications of the Schlieren Method of Photography. D. B. Gawthrop. *Rev. Sci. Instruments*, 2. *pp.* 522–531, *Sept.*, 1931.—A description is given of the apparatus necessary for the photography of wave phenomena and of invisible gases differing in density from that of the surrounding atmosphere, the method being dependent upon the principle of the refraction of light at a surface of discontinuity in the atmosphere. Photographic illustrations are given of various applications of the method, such as the study of gases diffusing in air, the effect of electric fields on flames, etc. The method may be applied to any problem in which small changes of optical density occur, and is not limited to disturbances occurring in gaseous systems. A. H.

827. Relative Sensitivity of Photographic Plates for Spectral Colours. W. Weizel and F. Gössler. *Zeits. f. techn. Physik*, 12, 11*a*. *pp.* 587–593, 1931.—Photographic plates of German manufacture were tested for sensitivity for seventeen different wave-lengths in the visible spectrum. The standard of reference was the panchromatic plate made by Perutz. The plates were exposed for a definite time to a constant light

V.3
193

source which illuminated the slit of a spectrograph; a Nitrophot lamp was employed. The plates were developed together for 5 min. in standard developer at a constant temperature of 17·25° C. The blackening of the plates was measured by a Waibel photometer for each wave-length. The results are recorded in tables and by graphic methods. F. J. B.

828. Highly-Dispersed Emulsions. Lüppo-Cramer. *Zeits. f. wiss. Phot.* 30. *pp.* 201–207, *Sept.*, 1931.—The problem is discussed of the much greater sensitivity of silver chloride compared with silver bromide when in correspondingly dispersed conditions, and a description is given of the effect of silver iodide in a grainless silver bromide emulsion. H. H. Ho.

829. Development of the Solarised Latent Image. A. P. H. Trivelli and E. C. Jensen. *Frank. Inst., J.* 212. *pp.* 351–367, *Sept.*, 1931. *Comm. No.* 465 *from the Kodak Research Lab.*—It is found that for normal exposures the density of the image varies directly with the logarithm of the concentration of potassium bromide in the developer. The proportionality does not hold so well for the solarisation region, whilst at the threshold of the first reversal of the solarisation no correlation at all is observed. A. H.

830. Intensifying Action of Hydrogen Peroxide and Organic Peroxides on the Latent Photographic Image. C. E. Barnes, W. R. Whitehorne and W. A. Lawrance. *J. Phys. Chem.* 35. *pp.* 2637–2649, *Sept.*, 1931.—The action of hydrogen peroxide, and of various organic peroxides, in intensifying the latent image is studied, employing various developing agents. With hydrogen peroxide it is found that the intensification is largely dependent upon the developer used. Of the organic peroxides *m*-chlorbenzoyl peroxide is the only one found to produce appreciable intensification. A. H.

831. Blackening of Photographic Plates by Positive Ions of the Alkali Metals. K. T. Bainbridge. *Frank. Inst., J.* 212. *pp.* 489–506, *Oct.*, 1931.—A short review is included of previous work on the blackening of photographic plates by positive rays and rays of an analogous nature. The blackening of Eastman X-ray plates, by positive ions, has been measured as a function of the energy of the ions of Li, Na, K, Rb and Cs. The energy of the ions required to produce a photographic density of $D = 0\cdot3$ with a one-minute exposure at a current density of $1\cdot32 \times 10^{-8}$ ampere per cm.^{2} ranged from 1420 electron-volts in the case of cæsium to 860 electron-volts in the case of Li^7. Approximately 10^5 ions are required at these energies to render developable one silver-halide grain. For a threshold density, $D = 0\cdot04$, under the same conditions the energy ranged from approximately 920 to 460 electron-volts for Cs and Li^7 respectively. Sensitivity comparisons were made between X-ray, process and Schumannised-process plates. Potassium ions with an energy as low as 137 electron-volts were recorded on Schumann plates, and it is possible that positive ions of one-third this energy can be recorded. AUTHOR.

832. Photographic Action of α-, β- and γ-Rays on Plates and Films Previously Treated with Chromic Acid and Pinakryptol Yellow. H. Wambacher. *Akad. Wiss. Wien, Ber.* 140. 2*a*. 5–6. *pp.* 271–291, 1931.—Pinakryptol yellow exerts a considerable desensitising action on ordinary photographic emulsions as regards electric light; with chromic acid the effect is smaller. The sensitivity towards γ-rays is reduced by about 70 % by the organic dye, and by a rather less amount by chromic acid. For β-rays, accompanied by some γ-rays, these conditions are reversed, chromic acid being by far the more active desensitiser; the curves obtained, especially after desensitising with pinakryptol yellow, resemble those obtained by Nacken for soft β-rays. Chromic acid, but not pinakryptol yellow, desensitises emulsions towards α-rays, and the effect is probably due not only to destruction of the nuclei, but also to action on the gelatin base. Prolonged exposure to α-rays effects considerable destructive action on both the ordinary and desensitised films.

H. F. G.

833. Law of Mirror Correspondence of Absorption and Fluorescent Spectra. Part I. W. L. Lewschin. *Zeits. f. Physik,* 72. 5–6. *pp.* 368–381, *Oct.* 21, 1931.—Experiments have been carried out at different temperatures between 20° and 70° C. on the comparison of the fluorescent and absorption spectral curves of various dyestuffs. Under the same condition, the two curves (on a frequency scale) are exact mirror images of each other. The result is considered to be a fundamental general law for fluorescent spectra. It holds good for benzene. While no examination of the detailed structure has yet been possible, the existence of series formulæ in the absorption and fluorescence of benzene, differing only in the sign of one term, indicates the probability of the truth of the law for the fine structure. [See following Abstract.] J. E.

834. Law of Mirror Correspondence and Influence of Temperature on the Fluorescence of Dyestuff Solutions. Part II. W. L. Lewschin. *Zeits. f. Physik,* 72. 5–6. *pp.* 382–391, *Oct.* 21, 1931.—The change of quantum efficiency of strongly fluorescent substances with temperature indicates that perfect efficiency should be rendered by lowering the temperature. The width of the fluorescent band as usually taken as the width between regions where the intensity falls to half the maximum, decreases with temperature. But if the width is taken as the integrated area of the spectral curve the " width " is independent of temperature. As regards the effect of temperature on the position of the maxima of fluorescence and absorption, it is shown that (1) the distance apart of the two maxima remains practically independent of temperature approaching each other only by about ¼ to 3 % of the distance at + 20° C. Two kinds of quenching effect are distinguished—an inner effect due to change of the configuration of the emitter with excitation and linked with a corresponding change of absorption, and an external quenching characterised by no change in the absorption spectrum. In internal quenching the ratio of emission to absorption for any pair of symmetrical lines is constant throughout the whole spectra. The nature and effect of the various quenching agents are discussed—temperature, concentration, solvent, and concentration of an added quenching agent. [See preceding Abstract.] J. E.

835. Kathode Luminescence of Diamond. M. V. John. *Indian Journ. Phys.* 6. *pp.* 305–308, *Oct.* 31, 1931.—Three small diamonds have been bombarded by kathode rays in a vacuum tube, and the radiations have been analysed with a spectrograph. In one of these, a continuous spectrum extending throughout the visible region with a strong band at 4147 Å. has been observed. In another, there is a narrow region of absorption at about 4157 Å., whereas in the third there is a strong continuous spectrum. This band is in the same position as the fluorescence band observed by Bhagavantam in the Raman spectra of some diamonds.

AUTHOR.

836. Absorption Spectra of the Vapours of Copper, Silver and Gold. R. G. Loyarte and A. T. Williams. *Univ. Nac. La Plata, Estudio Ciencias,* 5. *No.* 93. *pp.* 391–398, *Sept.*, 1931.—In addition to all the absorption lines previously recorded for copper, silver and gold, two new lines in the absorption spectrum of gold, at 3122·98 Å. ($1^2D_3 - 1^2P_2$) and 3029·22 Å. ($1^2D_3 - 1^2F_4$), have been observed. The results obtained are in conformity with the equation $N_1/N = \epsilon^{-E/RT}$, where N_1 is the number of excited atoms and N the total number of atoms. H. F. G.

837. Absorption Spectra of Phenanthripyridine Alkaloids. A. Girardet. *Chem. Soc., J. pp.* 2630–2637, *Oct.*, 1931.—The ultra-violet absorption spectra (3000–4500 Å.) of pukateine, laureleine and laurepukine and eight other related alkaloids have been determined and compared with those of morphine, thebaine and corydaline. The results are discussed in their relation to the structure of the molecules and the influence of the nature and position of substituent groups. H. F. G.

838. Absorption Spectra of Sulphur Compounds. Part I. L. Lorenz and R. Samuel. *Zeits. f. phys. Chem.* 14. *Abt.B.* 3–4. *pp.* 219–231, *Oct.*, 1931.—The absorption spectra of sixteen compounds of quadri- and hexavalent sulphur in the region 220–400 $m\mu$ have been determined, and are discussed in some detail in relation to their molecular structure.

H. F. G.

839. Visible Absorption Spectrum and Natural Frequency of the Permanganate Ion. K. Schnetzler. *Zeits. f. phys. Chem.* 14. *Abt.B.* 3–4. *pp.* 241–248, *Oct.*, 1931.—The absorption spectrum of crystals of potassium perchlorate containing (isomorphous) potassium permanganate exhibits in the region 4400–5600 Å. seven equally spaced bands due to the permanganate ion; the distance between successive bands is 766 cm.$^{-1}$, and their half-width is about 70 cm.$^{-1}$. Each band is accompanied by a fainter satellite on the shorter wave-length side; the distance between the band of longest wave-length and its satellite is about 300 cm.$^{-1}$, but with increase of wave-length the distance diminishes. The fine structure of the bands has been studied. The number of absorbing groups present is of the same order as the number of molecules, in sharp contrast with conditions obtaining for line spectra of all other crystals which have so far been examined. H. F. G.

840. Absorption of the Cadmium Resonance Line, 2288 Å., and Life of the 2^1P_1 State of Cadmium. M. W. Zemansky. *Zeits. f. Physik,* 72. 9–10, *pp.* 587–599, *Oct.* 30, 1931.—The absortion of the cadmium line $1^1S_0 - 2^1P_1$ (2288 Å.) by cadmium vapour has been determined over a range of pressures. The maximum absorption coefficient k_0 is given by $k_0 = 1\cdot64 \times 10^{-11}$ N, where N is the number of cadmium atoms per c.c., and the calculated life of the $2'p_1$ state is $1\cdot99 \times 10^{-9}$ sec. The value of f is 1·19, in close agreement with Kuhn's value of 1·20.

H. F. G.

841. Absorption Spectra of Hydrochloric Acid and of Bromine. (Mme.) N. Demassieux and V. Henri. *Comptes Rendus,* 193. *pp.* 591–592, *Oct.* 12, 1931.—When exceptionally pure materials are used for the preparation of HCl there is no trace of absorption so far as 2144 Å. The band usually found at about 2500 Å. is traced as due to bromine. F. S.

842. Infra-Red Absorption of Quartz. F. E. McGinnety. *Univ. Durham Phil. Soc., Proc.* 8, *pp.* 337–350, 1930–1931.—The data for fused and crystalline quartz from 2μ to 8μ are reviewed, and are unified by correcting for the thickness of the specimen and also for reflection at the surfaces. From $2 \cdot 5\mu$ to 5μ the curves for crystalline and fused quartz are somewhat similar, but from 5μ to 8μ there are noticeable differences; crystalline quartz absorbs more strongly than fused quartz beyond 5μ. The various bands are discussed, and tables of corrected transmission and absorption coefficients are given. A. C. M.

843. Infra-Red Absorption Spectra of Bicarbonates and Mercaptans. P. N. Ghosh and B. D. Chatterjee. *Zeits. f. Physik,* 72. 7–8. *pp.* 542–552, *Oct.* 28, 1931.—The absorption spectra of anhydrous powdered Na_2CO_3, K_2CO_3, $NaHCO_3$, $KHCO_3$ and NaOH have been investigated between 5 and 12μ with the prism spectrograph. For the bicarbonates and caustic soda bands are found at $6 \cdot 0$ and $12 \cdot 0\mu$. As there is no water present the band $6 \cdot 0\mu$ must be regarded as the first upper harmonic of the band $12 \cdot 0\mu$, and both are ascribed to a vibration of the type NaO. Between 1 and 5μ observations were made with a grating spectrograph, in combination with the prism, on $NaHCO_3$, NaOH and liquid C_2H_5SH. An absorption band was found for the first two at $2 \cdot 94\mu$, and is ascribed to O — H. Mercaptan was compared with alcohol, and the position of the two S — H bands was determined accurately as $2 \cdot 27$ and $2 \cdot 92\mu$.
H. N. A.

844. Infra-Red Absorption Spectra with the Photoconducting Cell. R. Freymann. *Comptes Rendus,* 193. *pp.* 656–659, *Oct.* 19, 1931.—The absorption and transmission spectra of twelve acyclic primary normal alcohols are studied by means of a thalofide cell made by Céma Fournier, with three stages of amplification, a copper-oxide rectifier and a d'Arsonval galvanometer. The results show that the bands at $0 \cdot 9\mu$ and 1μ are made up of at least two components each, the shorter wavelength being the more intense. In passing up the homologous series, the maximum of each band is displaced towards the greater wave-lengths. The band at $0 \cdot 9361\mu$ is probably the third harmonic of the band at 3μ, which is characteristic of the linkage O — H. E. E. F. d'A.

845. Absorption Bands in Ethylene Gas in the Near Infra-Red. R. M. Badger and J. L. Binder. *Phys. Rev.* 38. *pp.* 1442–1446, *Oct.* 15, 1931.—The absorption spectra of gaseous ethane and ethylene have been investigated by photographic methods in the region $\lambda\lambda 6500$–9500. In the case of ethane no absorption was found. In ethylene a rather strong band was found at $\lambda 8720$, which has a structure resembling that predicted by H. H. Nielsen for the oscillation-rotation bands of a molecule with moments of inertia in the ratio $1 \cdot 4 : 1 : 0 \cdot 14$. The following very provisional values for the moments of inertia of the ethylene molecule are given: $A_x = 31 \times 10^{-40}$, $A_y = 27 \times 10^{-40}$, $A_z = 3 \cdot 8 \times 10^{-40}$. AUTHORS.

846. Wave-Lengths of Strong Oxygen and Nitrogen Lines in the Region $\lambda\lambda 3880$–4705. C. S. Beals. *Dominion Astrophys. Obs. Victoria, Publ.* 6. 3. *pp.* 17–23, 1931.—Plates were taken at the Imperial College in London, and again later in Victoria, with a new grating spectrograph of high dispersion. The earlier measures are on the whole confirmed, but a systematic difference for some lines was discovered, which is attributed to the use at the Imperial College of fourth-order lines in some plates. Methods are discussed, the new instrument is described and tables of wave-lengths are given, comparing the present results with the previous measurements of Clark, Fowler and Freeman. M. A. E.

847. Rotational Analysis of the First Negative Group of Oxygen (O_2^+) Bands. D. S. Stevens. *Phys. Rev.* 38. *pp.* 1292–1311, *Oct.* 1, 1931.—The ultra-violet O_2^+ bands have been produced by a hollow kathode discharge, or with greater intensity from a mixture of helium with a small amount of oxygen in a large discharge tube. Photographs were taken in the second order of a 21-ft. Rowland grating (dispersion = 1·32 Å./mm.). The following bands were used for a rotational analysis: 1–8; 0–8; 1–9; 0–9. As was expected, since NO and O_2^+ have the same number of electrons, these bands correspond to a $^2\Pi \rightarrow {}^2\Pi$ transition like the double-headed β bands of NO. The lower $^2\Pi$ is case *a* as in NO. Unlike the case of NO, however, the upper $^2\Pi$ is case *b*. The lower $^2\Pi$ is regular, with a doublet separation A″ (corresponding to zero rotation) of 195 cm.$^{-1}$. In the upper $^2\Pi$ the value of the spin-orbital coupling coefficient A′ is + 8·2. Each band consists of eight branches (four P and four R), the Q branches apparently being too weak to appear on the plates. This is in agreement with theory. Λ-type doubling is negligible in the upper $^2\Pi$, but is present in the lower $^2\Pi$ state. Alternate levels in each successive Λ-type doublet are missing. This is as predicted by the quantum theory of homopolar molecules, since it is known that the nuclear spin of the oxygen atom is zero. The probable electronic configuration of the upper $^2\Pi$ state is given as . . . $2p\pi^3\ 3d\pi^2$, and that of the lower $^2\Pi$ state as . . . $2p\pi^4\ 3d\pi$. The constants of the molecule in the two electronic states are given by: $B' = 1{\cdot}048 - 0{\cdot}014v'$; $B'' = 1{\cdot}610 - 0{\cdot}009v''$; $r'_e = 1{\cdot}41 \times 10^{-8}$ cm.; $r''_e = 1{\cdot}14 \times 10^{-8}$ cm.; $A' = +\ 8{\cdot}2$ cm.$^{-1}$; $A'' = +\ 195$ cm.$^{-1}$. AUTHOR.

848. Relationships Between the Continuous and the Many-Lined Spectra of Hydrogen. Part IV. Y. Hukumoto. *Tohoku Univ., Sci. Reports*, 20. *pp.* 599–607, *Oct.*, 1931.—The continuous spectrum of the under-water spark has much in common with the continuous spectrum of the hydrogen molecule, and is also accompanied by the Fulcher bands of hydrogen, even if they show no discrete structure. The energy distributions in the two continuous spectra of hydrogen and under-water spark were compared spectrophotometrically, and seem to have their intensity maxima in almost the same region of the far ultra-violet. These observations lead to the conclusion that the dissociation of H_2 may more or less contribute to the continuous spectrum of the under-water spark. [For previous work, see Abstract 1861 (1930).] AUTHOR.

849. Excitation of the Visible Spectrum of Helium. Part II. J. S. Townsend and F. L. Jones. *Phil. Mag.* 12. *pp.* 815–823, *Oct.*, 1931.—The intensities of the principal lines in the spectrum of the light from a luminous discharge in helium were compared by photoelectric cells for different values of the mean energy of the electrons in the discharge. In the experiments described a large increase in the intensity of the light from the discharge was found to be accompanied by only a small increase in the mean energy of the electrons. This result is accounted for by the theory of the distribution of the energies of the electrons about the mean energy. The theory shows that a small increase in the mean energy of the electrons is accompanied by a large increase in the number of electrons with large energies. The values of the excitation energies calculated depend on the formula for the distribution of the energies of the electrons. Two formulæ are considered: one for the case when the distribution of energies is set up by diffusion, and the other when the distribution is Maxwellian. The diffusion formula gives a value for the excitation energy of 10 volts, while Maxwell's formula gives values between 20 and 25 volts. When the band spectrum of helium was observed the excitation energies were found to be lower. [For Part I, see Abstract 2277 (1931).]

AUTHORS.

850. First Spectrum of Krypton. W. F. Meggers, T. L. de Bruin and C. J. Humphreys. *Bureau of Standards, J. of Research,* 7. *pp.* 643–657, *Oct.*, 1931.—A Geissler tube with a capillary of small bore was used "end on" to make a new description of the first spectrum of krypton. On account of the increased intensity compared with tubes viewed side on, this procedure permitted the use of a higher-powered spectrograph, and has added a large number of new lines. Thus the wave-length and intensity data have been improved, several close pairs of lines have been resolved, and the total number of lines characterising the spectrum of neutral krypton atoms has been extended from about 200 to 460. The spectral terms previously reported have been confirmed by finding many of the predicted combinations, and the analysis has been extended so that the number of classified lines has increased from 180 to 350. AUTHORS.

851. Excitation of Spectral Lines by Impact of Slow Positive Ions. A. Güntherschulze and F. Keller. *Zeits. f. Physik,* 72. 3–4. *pp.* 143–154, *Oct.* 14, 1931.—A glow discharge was produced by means of a grid kathode of 1400 sq. cm. surface. The lines excited and the voltages required are detailed for the gases He, Ne, A, Kr, H_2, N_2 and O_2. F. S.

852. Band Spectrum of Yttrium Oxide (With a Note on the ScO and LaO Systems). L. W. and R. C. Johnson. *Roy. Soc., Proc.* 133. *pp.* 207–219, *Sept.* 1, 1931.—About 100 band heads in the band spectrum of yttrium oxide, YO, are photographed in the first order of a 21-ft. grating. These are assigned to two systems, ${}^2\Pi \rightarrow {}^2\Sigma$ and ${}^2\Sigma \rightarrow {}^2\Sigma$, having a common ground state. The vibration structure of these bands is analysed and values of the molecular constants for the states are deduced. The band spectrum of YO is similar to those of ScO and LaO, since these three molecules have similar external electronic structures. Comparison with the YO bands leads to an interpretation of the ScO and LaO band spectra. J. E. K.

853. Band Spectra of Negative Ions. R. Mecke. *Zeits. f. Physik,* 72. 3–4. *pp.* 155–162, *Oct.* 14, 1931.—It is shown by aid of the spectroscopic displacement law that the known band spectra of Be and Mg hydrides belong to the negative ions $(BeH)^-$ and $(MgH)^-$. It is shown by similar arguments that the hydrides CuH, AgH, AuH, ZnN^+, CdH^+ and HgH^+ depend on the binding of four electrons, so that the electron terms of the molecule are not built upon the ground terms $(s^2p^6d^{10})s$, but probably upon $(s^2p^6d^8)s^2p$. F. S.

854. Silver-Hydride Bands. E. Bengtsson and E. Olsson. *Zeits. f. Physik*, 72. 3–4. *pp.* 163–176. *Oct.* 14, 1931.—A new method of producing the bands is described. Between 3180 Å. and 4700 Å., 27 bands have been analysed and arranged in the $^1\Sigma - {}^1\Sigma$ system, and the band constants given. Formulæ for isotope separation are proved, or new formulæ proposed, while interesting points in the analysis are discussed. F. S.

855. Significance of the Mercury Bands. H. Kuhn. *Zeits. f. Physik*, 72. 7–8. *pp.* 462–471, *Oct.* 28, 1931.—The diffuse band series observed in the mercury spectrum at wave-lengths greater than 2537 Å. are regarded as " fluctuations " [see Abstract 156 (1931)]. The upper state of the " core " series is attributed to the $^3P_0$ state, and that of the " wing " series to the $^3P_1$ state of the atoms. The extrapolated heat of dissociation of the mercury molecule is $1 \pm 0 \cdot 5$ k. cal. The absorption at about 3300 Å. and that in the blue-green region are associated with the wing and core series, respectively. The relation between the variation of absorption with temperature and the heat of dissociation is discussed. Winans' explanation of the broadening of spectral absorption lines has been somewhat modified. H. F. G.

856. Separation Between the ^2F Levels of Cerium Ions. R. Brunetti and Z. Ollano. *N. Cimento*, 8. *pp.* 281–290, *Aug.–Sept.–Oct.*, 1931.—The Raman spectra of the nitrate and chloride of cerium in aqueous solution have been examined. $Ce(NO_3)_3$ shows the ordinary frequencies due to NO_3, together with a line with frequency separation 1473 cm.$^{-1}$, not found in other nitrates. $CeCl_3$ shows the chloride lines, and one with separation 1640 cm.$^{-1}$. These are interpreted as due to the quantum leap from the state $^2F_{5/2}$ to $^2F_{7/2}$. The separation is less than Sommerfeld's theoretical value, but agrees with the results of Brunetti in an investigation of the magnetic properties. The disagreement with theory is considered to be due to the external position of the ^2F level with respect to the atomic core. It appears also that the separation depends on the salt of which the ion forms a part. J. H. A.

857. Fine Structure of Zinc Arc Lines in Vacuum, and Energy Levels of Zinc. W. Mohammad and P. N. Sharma. *Phil. Mag.* 12, *pp.* 726–728, *Sept.*, 1931.—The paper is a repetition and correction of the work described in Abstract 1269 (1931). Twenty lines have been measured in the zinc arc spectrum, between $\lambda = 6362 \cdot 58$ and $2756 \cdot 53$. Of these only two are double, the rest being simple. It is concluded that the $2d''$ level is the only one which is not simple; this one has a term separation of $0 \cdot 450$ cm.$^{-1}$. J. H. A.

858. Second Spark Spectrum of Carbon, CIII. B. Edlén. *Zeits. f. Physik*, 72. 9–10. *pp.* 559–568, *Oct.* 30, 1931.—A large quartz spectrograph and a vacuum grating instrument were used. Tables of observed values are given and 52 single lines and 46 triplet groups have been identified. Combinations of forbidden terms show remarkable intensity, but no inter-combinations have been observed. An ionisation potential $(2'S)$ of $47 \cdot 652$ volts is deduced, the metastable 2^3P state lying $6 \cdot 465$ volts above the ground term. F. S.

859. Spark Spectra of Tellurium, TeIV and TeVI. K. R. Rao. *Roy. Soc., Proc.* 133. *pp.* 220–228, *Sept.* 1, 1931.—The higher spark spectra of Te have been photographed in the region λ1500 to λ500 with a vacuum spectrograph, and in the region λ2000 to λ4000 with quartz instruments. The doublet system of TeIV has been identified and a term scheme suggested. The largest term, $5pP_{\frac{1}{2}} = 305{,}091$ cm.$^{-1}$, gives an ionisation potential of about 37·7 volts for TeIV. Three pairs of lines with $\Delta\nu = 11{,}814$ cm.$^{-1}$ have been identified as combinations between the deep 5*s*S, 5*p*P, 5*dD* and 6*s*S terms of TeVI and a term scheme is proposed for this spectrum. The ionisation potential of TeVI is found to be about 72 volts. J. E. K.

860. Interpretation of the Spectra of CaF and SrF. A. Harvey. *Roy. Soc., Proc.* 133. *pp.* 336–350, *Sept.* 1, 1931.—The band spectra of CaF and SrF are examined under high dispersion in both emission and absorption. The different appearance of the bands with the two methods of excitation is shown in all cases to be a natural consequence of the difference in temperature, the apparent absence of certain sequences being due to the extremely high value of the rotational quantum number at which the heads are formed. Estimates are made of the values of the rotational constants for CaF, and for the lower $^2\Sigma$ state the values obtained are $I''_0 = 86 \times 10^{-40}$ gm. cm.^{2}, $r''_0 = 2 \cdot 0 \times 10^{-8}$ cm. AUTHOR.

861. Nuclear Moment of the Indium Atom. J. C. McLennan, E. J. Allin and K. E. Hall. *Roy. Soc., Proc.* 133. *pp.* 333–335, *Sept.* 1, 1931.—A re-examination is made of several lines in the indium spectrum using several different methods of high dispersion. It is concluded from a study of the number, intensity and separations of the components of the various lines examined that the best value of the nuclear moment of the indium atom is $1/2\ h/2\pi$, as reported earlier [see Abstract 489 (1931)] whereas Jackson [see Abstract 124 (1931)] finds the value of the nuclear moment to be unity. A. H.

862. Hyperfine Structure of Mercury. Parts I and II. K. Murakawa. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 326. *pp.* 243–255, *Sept., and No.* 331. *pp.* 1–5, *Oct.*, 1931.—The hyperfine structure and the Paschen-Back effect of the Hg line $\lambda 4047 (6^3P_0 - 7^3S_1)$ is determined. Measurements are made in the sixth order of a 15-ft. concave grating and for field strengths up to 28,500 gauss. The Paschen-Back effect determines uniquely the nuclear moment of all the mercury isotopes. The even isotopes 198, 200, 202 and 204 have $I = 0$, isotope 201 has $I = 3/2$ and isotope 199 has $I = 1/2$. An explanation of the observed hyperfine structure of the Hg line $2536 (6^1S_0 - 5^3P_1)$ is given. The relative shifts of the even isotopes in the terms 6^1S_0, 7^3S_0 and 7^1S_0 are deduced. In the second paper hyperfine structure measurements of the lines λλ4078, 4358, 5461, 2753, 2894, 3341 and 4916 and their interpretation are given. It is found that when the hyperfine structure terms of isotope 199 ($I = 1/2$) are normal the corresponding terms of isotope 201 ($I = 3/2$) are inverted, and vice versa. J. E. K.

863. Systematics and Statistics of Nuclei. K. Murakawa. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 332. *pp.* 6–7, *Oct.*, 1931.—Systematics of nuclear moments confirm the view that the nuclear moment is an integer or half-integer, according as the number of protons in the nucleus is even or odd, and is independent of the number of electrons in the nucleus. This shows that a nuclear electron cannot possess a spin of $\frac{1}{2}$ and probably has a spin of 0 or 1. Any nucleus containing an even or odd number of protons satisfies the Bose or the Fermi statistics respectively, regardless of the number of nuclear electrons. Each proton in the nucleus must therefore satisfy the Fermi statistics and each electron in the nucleus must satisfy the Bose statistics. J. E. K.

864. Hyperfine Structures and Nuclear Moments of Mercury. H. Schüler and J. E. Keyston. *Zeits. f. Physik,* 72. 7–8. *pp.* 423–441, *Oct.* 28, 1931.—New photographs of the hyperfine structure of important mercury arc lines in the region 7000 to 4000 Å. have been taken. The hyperfine components have been arranged in term schemes and the nuclear moments of mercury determined. The isotopes 198, 200, 202 and 204 have $I = 0$. Isotope 199 has $I = 1/2$ and isotope 201 has $I = 3/2$. The hyperfine structure terms of 199 are normal, but those of 201 are inverted, as in the case of cadmium. The term separations for $I = 1/2$ and $I = 3/2$ are very nearly equal. As a result of an isotope displacement effect the even isotopes appear separated in certain lines. A qualitative term scheme is set up for these displacements. The displaced even isotopes and the centres of gravity of the components of the odd isotopes lie in the same sequence as the nuclear masses of the isotopes. The $^1P_1$ term sequence exhibits anomalous isotope displacements and term separations which are probably connected with the anomalous energy values of this series. The observed intensities agree with the theoretical intensities calculated from intensity rules and Aston's mass-spectrograph measurements of the mercury isotopes. The true intensities are only observed under the most favourable and least disturbed conditions of excitation. Excitation in the water-cooled mercury arc lamp causes the appearance of characteristic intensity changes. J. E. K.

865. Hyperfine Structure and Absorption of the Mercury Line 2537 Å. W. Zehden and M. W. Zemansky. *Zeits. f. Physik,* 72. 7–8. *pp.* 442–446, *Oct.* 28, 1931.—It is shown that the interpretation of the hyperfine structure of the Hg resonance line, 2537 Å., given by Schüler and Keyston is in complete agreement with the absorption measurements made by Kopfermann and Tietze on this line. J. E. K.

866. Angular Distribution of Raman Scattering. D. P. Ray-Chaudhuri. *Zeits. f. Physik,* 72. 3–4. *pp.* 242–246, *Oct.* 14, 1931.—The angular distribution of the intensity of the Raman lines $\lambda\lambda$4215, 4555 and 4617 scattered by benzene was measured for angles between 15° and 145°. Within the accuracy of the experiment, the distribution followed the $1 + \cos^2\theta$ law, θ being the angle between the incident and scattered light. A. C. M.

867. Intensity and Polarisation of the Raman Lines of Cyclic Hydrocarbons. J. Weiler. *Zeits. f. Physik,* 72. 3–4. *pp.* 206–214, *Oct.* 14, 1931.—Consideration of the measurements of Bhagavantam, Sircar and Daure in the light of Placzek's theory of the intensity and polarisation of the Raman lines of polyatomic molecules indicates that the 992 $cm.^{-1}$ line of benzene and the 803 $cm.^{-1}$ line of cyclohexane are due to vibrations of the carbon atoms in a radial direction; the same probably obtains for the lines at 826, 886 and 905 $cm.^{-1}$ of cyclohexane, cyclopentane and cyclopentene respectively. Bhagavantam's suggestion that the Raman frequency of 992 $cm.^{-1}$ is due to opposing tangential vibrations of adjacent carbon atoms contradicts Placzek's theory. Vibrations of this type are probably responsible for the benzene infra-red absorption line at 1030 $cm.^{-1}$, which, although not present in the Raman spectrum of benzene itself, appears in those of the benzene derivatives owing to destruction of the trigonal symmetry; it appears also in the Raman spectrum of other cyclic hydrocarbons and of heterocyclic compounds such as pyridine and thiophene. H. F. G.

868. Relative Intensities of Stokes and Anti-Stokes Lines in the Raman Spectrum. S. C. Sirkar. *Indian Journ. Phys.* 6. *pp.* 295–303, *Oct.* 31, 1931.—The ratio of the intensities of the Raman lines of frequencies $(\nu + \nu_{mn})$ and $(\nu - \nu_{mn})$ has been determined by the method of parallel displacement of blackening: log intensity curves in the case of two lines due to carbon tetrachloride having ν_{mn} equal to 1368×10^{10} and 945×10^{10} respectively. It has been found that the said ratio, as obtained experimentally, is represented more accurately by the expression

$$\left(\frac{\nu + \nu_{mn}}{\nu - \nu_{mn}}\right)^4 \cdot e^{-\frac{h\nu_{mn}}{KT}}$$

as given by Placzek's theory, than by the Boltzmann factor alone. AUTHOR.

869. Raman Spectra of Organic Crystals and Solutions. P. Krishnamurti. *Indian Journ. Phys.* 6. *pp.* 309–317, *Oct.* 31, 1931.—Raman spectra of a number of crystalline acetates, oxalic acid, ammonium oxalate, hexachlorethane, urea and hexamethylene-tetramine have been studied. The changes in the frequencies when dissolved in water have been examined with lead acetate, urea and hexamine. Striking changes in the C — H frequencies are observed in the case of hexamine when passing into solution, probably due to the formation of a hydrate. Practically no changes take place when hexachlorethane is dissolved in CCl_4 or ether. The C = O frequency (usually about 1700 $cm.^{-1}$) fails to appear in the spectra of the acetates and of urea, though they are supposed to contain the C = O linkage. The possibility of urea existing in a tautomeric form not containing the carbonyl group is discussed. AUTHOR.

870. Raman Spectra of Organic Substances. Nitro-Compounds, Nitrates and Nitrites. A. Dadieu, F. Jele and K. W. F. Kohlrausch. *Akad. Wiss. Wien, Ber.* 140. 2*a.* 5–6. *pp.* 293–319, 1931.—The substances studied were: phenylnitromethane, *o*-, *m*-, *p*-nitrotoluol, *o*-, *m*-, *p*-nitrobenzoic acid, *m*-, *p*-nitrobenzaldehyde, nitro-ethane, *n*-nitropropane, *n*-nitrobutane, *n*-nitropentane, nitric acid, nitrates of methyl, ethyl, *n*-propyl and *n*-butyl radicals; nitrites of the same radicals together with *iso*-amyl nitrite, and also nitrites of sodium, potassium, calcium and barium. All substances were studied as liquids or in solution. The structure of the NO_2 group is discussed as a central force system and as a valence force system. A. C. M.

871. Raman Spectra of Organic Substances. Cis- and Trans-Isomers. A. Dadieu, A. Pongratz and K. W. F. Kohlrausch. *Akad. Wiss. Wien, Ber.* 140. 2*a.* 5–6. *pp.* 353–368, 1931.—The substances discussed are: dibromethylene, *iso*-crotonic acid, crotonic acid, *iso*-crotonic acid and crotonic acid methyl esters, β-chlor-*iso*-crotonic acid and β-chlorcrotonic acid in chloroform, di-methyl and di-ethyl esters of maleic and fumaric acids. The object of the work was to provide more data for the discussion of cis- and trans-isomerism. A. C. M.

872. Measurement of Polarisation of Spectral Lines. W. Hanle. *Zeits. f. Instrumentenk.* 51. *pp.* 488–490, *Sept.*, 1931.—Observation of the state of polarisation of spectral lines can be vitiated through the polarising action of the spectrograph itself. It is better in investigating the state of polarisation of lines if the light can be depolarised before passage through the spectrograph. In the usual method, the light is divided into two beams polarised mutually at right angles (*e.g.*, by a calcite crystal) and the relative intensity of the lines due to the two beams is determined. In the method described, these two beams before entering the spectrograph are passed through a depolarising crystal. This last consists of a calcite slice, slightly wedge-shaped, about 2 mm. thick. The axis lies parallel to one end-face, perpendicular to the beam, and it makes 45° with the directions of polarisation of the light from the first calcite crystal. The second calcite slice is too thin to give appreciable double-refraction, but turns linearly polarised into elliptically polarised light. The effect of the small wedge-angle is that the beam emerging has different ellipticities from different parts of the cross-section, and thus practically natural light arrives at the slit. The depolarisation is independent of the wave-length. A. C. M.

873. Multiplet Structure and Zeeman Effect. J. B. Green and R. A. Loring. *Phys. Rev.* 38. *pp.* 1289–1291, *Oct.* 1, 1931.—Houston's method [see Abstract 2483 (1929)] as applied to triplets and singlets cannot account for any inversions in the triplet terms. This is probably due to the fact that spin-spin and mutual spin-orbit interactions are neglected. The results of Houston's and Goudsmit's work are applied to the Zeeman effects of the spectra of SnIII and SbI, and the agreement is found to be very satisfactory. AUTHORS.

874. Influence of Pressure and of Foreign Gases on the Weakening of the Balmer Lines by Weak Magnetic Fields. H. Stahl. *Zeits. f. Physik*, 72. 7–8. *pp.* 478–487, *Oct.* 28, 1931.—The diminution of the intensity of the Hα, Hβ and Hγ emission from hydrogen canal rays under the influence of a weak magnetic field increases logarithmically with increase of the gas pressure; with increase of the magnetic field the diminution increases to a limiting value, which depends on the pressure, and it is always smaller in a longitudinal field than in a transverse field. The intensity is increased by the presence of nitrogen, oxygen or helium, and no diminution of the component parallel to the rays has been observed. Helium canal rays produce excitation in hydrogen, and a small magnetic weakening appears to occur. Interpretation of the magnetic effect in terms of the Larmor precession of harmonic oscillators does not yield results in full accordance with these observations. It is probable that the effect is due primarily to a weakening of the polarised component of the emission, the limiting value corresponding with complete depolarisation; this view accords with the results obtained and with the results of previous investigators. H. F. G.

875. New Effect Produced by Action of X-Rays on Matter. G. I. Pokrowski. *Phys. Rev.* 38. *pp.* 925–930, *Sept.* 1, 1931.—This paper describes an investigation of the weak radioactivity which some heavier elements acquire after being irradiated by X-rays. The first method of investigation of this effect is based on the measurement of the ionisation produced by the sample after irradiation. The second method consists in the counting of the scintillations produced by particles emitted by the irradiated substance. The combination of these two methods makes it possible to determine the mean energy of each emitted particle.

This energy is of the order of 10^{-6} erg. It seems quite impossible that particles of such energy could be emitted from the extranuclear electrons. It is much more probable that they originate in the atomic nuclei. On the other hand, it is not possible to explain such results by radioactive contamination. Some possible explanations of the phenomena observed are discussed. AUTHOR.

876. X-Ray Absorption by a Thomas-Fermi Atom. L. C. Roess and E. H. Kennard. *Phys. Rev.* 38. *pp.* 1263–1269, *Oct.* 1, 1931.—Calculations were made on the K shell of tin, the K electron being assumed to move according to the Dirac relativistic equation in a modified Fermi-Thomas field. The ionisation potential for a K electron thus found exceeds the observed energy of the K absorption edge by only 0·48 %. Mass absorption-coefficients for the K shell for wave-lengths 1, 1·5 and 2·5 times the absorption-edge wave-length were found to be 2·42, 12·10, 37·42 respectively, as against Richtmyer's observed values of 2·36, 11·0, 37·0. AUTHORS.

877. Reflection and Diffraction of X-Rays. T. H. Laby and R. T. W. Bingham. *Roy. Soc., Proc.* 133. *pp.* 274–291, *Sept.* 1, 1931.—The authors have found that X-rays of wave-lengths 13·3 Å. (CuLα) and 44·7 Å. (CKα) are reflected by glass, quartz and stainless steel at angles considerably greater than the calculated critical angles. The reality of this reflection is of interest, not only as a test of the theory of dispersion due to Drude and Lorentz, but also because the phenomena imply that a ruled grating may be used to diffract X-rays at larger glancing angles than is usually assumed. The effect is due to the fact that there is a higher absorption of X-rays in the reflecting surfaces than has previously been supposed. It was found that carbon K radiation could be brought to a focus by reflection from a concave glass surface of 6 cm. radius at a large glancing angle (45°), an image being formed on the photographic film. A plane grating with 4250 lines per cm., ruled on glass, was tested in the vacuum spectrometer just described by Bingham. An analysis was made of carbon radiation, and the K line was identified up to the 13th positive order in the positive spectrum, and the 18th negative order; no other lines were found. A number of lines were identified in copper spectra. The intensity of the radiation in the carbon spectrum has been studied by means of a Moll microphotometer applied to an X-ray photograph. A coincidence method of measuring wave-lengths is described. H. N. A.

878. Reflection of Long X-Rays. C. B. O. Mohr. *Roy. Soc., Proc.* 133. *pp.* 292–303, *Sept.* 1, 1931.—A special vacuum apparatus designed by T. H. Laby [see following Abstract] was employed, which was suitable for long-wave reflection in general. The X-ray tube and apparatus are contained in a common vacuum. AlKα radiation from an aluminium target was isolated by a gypsum or mica crystal, and the CuLα radiation from a copper target by a ruled grating, with 10,800 lines per inch. Mirrors of quartz, calcite, glass, stainless steel, silver and 22-carat gold were used at 8·32 Å., and mirrors of quartz, glass and stainless steel at 13·3 Å. It was found that the percentage of radiation reflected diminished as the density of the mirror increased. Curves were obtained for the variation of the reflected ray with the angle of glancing incidence. These showed first a gradual fall, the rate of which began to increase more and more to a maximum. The rate of fall then began to diminish, and some reflection continued for some time after what is sometimes called the critical angle was passed. A series of theoretical curves was constructed, in which different amounts of absorption in the material were assumed, and the experimental curves were fitted to these. This was possible for the light mirrors, but for steel, silver and gold large discrepancies were found.

H. N. A.

879. Vacuum Spectrometer for Long Wave-Length X-Rays. R. T. W. Bingham. *Roy. Soc., Proc.* 133. *pp.* 266–274, *Sept.* 1, 1931.—The instrument was designed by T. H. Laby. A Seeman spectrometer with a single slit placed between the crystal, or ruled grating, and the photographic plate is employed, with an accurate circle for measuring angles. Spectrometer and X-ray tube are placed in a common vacuum. It has been used, with a method similar to Rowland's coincidence method, to measure the wave-length of the $AlK\alpha_{12}$ line relative to the fifth and sixth order of the $CuK\alpha_{12}$ doublet, using a sugar crystal. Correcting for deviation from the Bragg law the result is 8315 X.U., taking 1539·23 X.U. for the copper doublet. The results were reproducible to 1 X.U. The instrument has also been found to have a high speed for studying reflection and diffraction phenomena. H. N. A.

880. Hilger X-Ray Crystallograph and the Cubic Crystal Analyser. S. Zeidenfeld. *Phys. Soc., Proc.* 43. *pp.* 512–523, *Sept.*, 1931.—A description is given of an X-ray crystallograph designed on the principle used by Seeman and Bohlin [see Abstracts 1512 (1919) and 993 (1920)] in which the slit, specimen to be analysed and photographic film are disposed along the circumference of a circular camera. Typical crystallograms obtainable are shown. The cubic crystal analyser is described and some examples demonstrating its use are given. AUTHOR.

881. Theory of the Double Crystal Spectrometer. M. v. Laue. *Zeits. f. Physik,* 72. 7–8. *pp.* 472–477, *Oct.* 28, 1931.—The double crystal spectrometer may be employed to determine the reflection curve of a single crystal only when the curve is symmetrical. The intensity distribution may be calculated if the centre of symmetry is known as a function of the wave-length. The instrument cannot, however, be employed to determine whether the reflection curve is of the necessary type. H. F. G.

882. Effect of General Radiation in the Diffraction of X-Rays by Liquids. W. C. Pierce. *Phys. Rev.* 38. *pp.* 1409–1412, *Oct.* 15, 1931.—Previous work has shown that the amount of general radiation transmitted by a single filter may cause peaks in the diffraction pattern of liquids. Balanced strontium and zirconium filters are used to study the magnitude of this effect in X-rays from a molybdenum tube operating at 35 kV. Zirconium alone does not give sufficient filtration under these conditions, but by use of the two filters the effects of the general and characteristic radiation may be completely separated. AUTHOR.

883. Higher Order Effects in the Diffraction of X-Rays by Liquids. W. C. Pierce. *Phys. Rev.* 38. *pp.* 1413–1419, *Oct.* 15, 1931.—The X-ray diffractions of liquid carbon tetrachloride, chloroform, benzene, solutions of carbon tetrachloride in benzene, *o*-dichlorbenzene and *m*-dichlorbenzene have been determined for $MoK\alpha$ rays by the ionisation spectrometer. All give a main peak characteristic of liquids, and in addition the halogen compounds give other maxima in the intensity-angle curve at large angles. This effect is the same for carbon tetrachloride, pure or in solution, and is consequently thought to be due to internal interference caused by scattering from the chlorine atoms. Debye's relation for the scattering of single atoms cannot be applied because the positions of the peaks obtained from solutions are masked by the molecular scattering of the solvent. AUTHOR.

884. Regular Reflection of X-Rays from Quartz Crystals Oscillating Piezoelectrically. G. W. Fox and J. M. Cork. *Phys. Rev.* 38. *pp.* 1420–1423, *Oct.* 15, 1931.—Laue patterns from quartz crystals oscillating piezoelectrically have been observed to be more intense than similar patterns from non-oscillating crystals. In this investigation, regular Bragg reflections from the face of crystals, oscillating and non-oscillating, have been observed in order to notice any variation in intensity or line width. No effect of this kind has been observed. These results are interpreted as negativing the existence of Zwicky blocks, rocking slightly by the piezoelectric oscillations, as proposed by Langer. An explanation of the observed effect with Laue spots based upon the extinction effect in perfect crystals is proposed. AUTHORS.

885. Retarded Matrix Terms in the Theory of Scattering and Absorption of X-Rays. J. Fischer. *Ann. d. Physik,* 11. 4. *pp.* 489–520, *Oct.* 13, 1931.—In problems concerning "non-periodic" atomic processes, the evaluation of certain matrix integrals offers considerable difficulty. The perturbed eigenfunction is obtained in the form of an infinite series. Wentzel [see Abstract 1484 (1930)] has used parabolic coordinates in place of polars, in problems connected with the H atom, thereby replacing the infinite series by an infinite integral which can usually be evaluated. An exact solution of the problem of the Compton effect in the H atom in the normal state has thus been obtained. The author extends Wentzel's work to the calculation of the matrix integrals in the case of the H atom in any initial condition. In particular he treats the Compton effect and uses the expression obtained to determine the directional distribution of recoil electrons from the L-level. The function which determines the photoelectric effect is also calculated. N. D.

886. Scattering of X-Rays from Paraffin, Aluminium, Copper and Lead. A. W. Coven. *Phys. Rev.* 38. *pp.* 1424–1431, *Oct.* 15, 1931.—The radiation from a tungsten-target X-ray tube operated at 80 kV was filtered through 0·244 cm. of aluminium and the intensities of the scattered radiations from paraffin, aluminium, copper and lead were observed by the ionisation method. The scattered intensities at angles in the range of 30° to 120° with the forward direction of the primary beam were compared with the scattered intensities at 90°. Values of the intensity at 90° for paraffin were compared with the intensity at 90° for the other materials. The scattering from paraffin and aluminium was at an effective wave-length of 0·32 Å., from copper 0·26 Å. and from lead 0·27 Å. The Dirac value of the scattering from paraffin at 90° was used as the basis for calculating the absolute values of the scattering per gm. and the scattering per electron. AUTHOR.

RADIOACTIVITY.

887. Spinthariscope for Measuring Radioactivity. H. A. Mangan and H. Schlundt. *Am. Electrochem. Soc., Trans.* 59. *pp.* 199–205, 1931.—The spinthariscope is serviceable in rapidly establishing the fact of radioactivity in living persons; but in its present form it is quite inferior to the electroscope for accurate quantitative estimation of small quantities of radioactivity emanations. AUTHORS.

888. Radioactive Measurement of Geologic Time: Age of Wilberforce Uraninite. G. Kirsch and A. C. Lane. *Am. Acad., Proc.* 66. 10. *pp.* 357–379, *July*, 1931.—The formula of Holmes and Lawson: $\text{Age} = \text{PbC}/(\text{U} + k\text{Th})$, where C is a constant, k the "lead ratio," *i.e.*, the ratio of the rates of lead production from thorium to that from uranium and Pb, U and Th the percentages of these metals respectively, is criticised, and 0·25 deemed a more correct value of k than 0·38, while C = 7100. The method thus revised applied to uraninite from Wilberforce gives the probable age as within 10 % of 1030×10^6 years. The interpretation of k is then discussed with the conclusions that the age of minerals possessing crystal structure without having been heated to incandescence, *e.g.*, thorianite and bröggerite, is correctly deducible from k; silicates and other minerals where the anion is a weak acid, *e.g.*, thorite, have k variable, the age deduced wherefrom indicates the time of the last pneumatolytic or hydrothermal activity that affected the mineral; and similarly as regards radioactive fissure minerals of pneumatolytic or hydrothermal origin. Lastly a method for deducing the age of a pegmatite dyke from that of its contained radioactive minerals is indicated. [See Abstracts 522 and 1294 (1931).] C. A. S.

889. Estimation of Radioactive Substances in the Air. G. Aliverti. *N. Cimento*, 8. *pp.* 233–245, *July*, 1931.—The method adopted is based upon Sella's outflow method. The air is aspirated through a brass cylinder 10 cm. wide at the rate of 2 l. per sec. A cylinder along the axis of the cylinder is kept charged at 8000 volts, and some hundred needles are mounted nearly in contact with it. The potential of the cylinder is determined every 5 min. by means of an Edelmann-Lutz electrometer. All the Ra, Ac and even Th constituents may be separately determined with the aid of linear equations. E. E. F. d'A.

890. Ionisation Produced by Radon in Spherical Vessels. G. Glockler and G. B. Heisig. *J. Phys. Chem.* 35. *pp.* 2478–2491, *Sept.*, 1931.—By an extension of Lind's average path law [see Abstract 373 (1928)] equations for the ionisation, and Mund's efficiency factors, for both 100 % RaA + C and 70 % RaA + 93 % RaC on the wall, are deduced for spherical vessels of any size, and the air equivalent pressures for a vessel of 1 cm. radius are given. Analogous factors are deduced by means of the complete average path law, comparison of the results showing a maximum deviation from those of Mund of only 3·3 %. Initial and average intensities of ionisation are calculated, the latter by two methods differing by only 1 %. A method for determining the ionisation in other gases is worked out and exemplified by application to acetylene. [See also following Abstract.] C. A. S.

891. Action of Radon on Unsaturated Hydrocarbons. G. B. Heisig. *Am. Chem. Soc., J.* 53. *pp.* 3245–3263, *Sept.*, 1931.—Using methods previously described [see Abstract 887 (1926) and preceding Abstract] the following results were obtained by the action of α-rays from radon. The figures show (*a*) the average percentage of the volume of hydrogen and methane formed on the diminution in volume of hydrocarbon caused and (*b*) the number of molecules of hydrocarbon reacting per ion pair formed (M/N): On allene (*a*) 4·3 and 5·4, (*b*) 10·0 and 10·7; allylene (methylacetylene) (*a*) 6·1, (*b*) 8·3; dimethylacetylene (*a*) 11·5, (*b*) 5·8; 2-butene (*s*-dimethylethylene) (*a*) 16·1, (*b*) 3·8; isoprene (*a*) 4·0, (*b*) 11·5 and 10·3. The products of the reaction on allene and allylene were light coloured liquids changing to similar solids; on dimethylacetylene and 2-butene dark liquids; on isoprene a light coloured very viscous liquid; no further attempt to determine their nature was made. The results are discussed, and the values of M/N shown to be additive and constitutive, and not inconsistent with the ion cluster theory. C. A. S.

892. Position of Uranium Z in the Uranium Degradation Series. E. Walling. *Zeits. f. phys. Chem.* 14. *Abt.B.* 3–4. *pp.* 290–296, *Oct.*, 1931.—The ratio of the activities of uranium Z to uranium X as a function of the age of the uranium X preparation used has been redetermined. The results indicate that the parent substance of uranium Z is uranium X, which undergoes two simultaneous β-ray transformations; this type of change has not previously been observed. The nature of the degradation product of uranium Z is discussed; it is definitely not an atom which undergoes a β-ray change, and is probably identical with uranium II; its half-life period is 240 years. H. F. G.

893. Radioactive Disintegration. A. Bramley. *Nat. Acad. Sci., Proc.* 17. *pp.* 579–583, *Oct.*, 1931.—Sommerfeld has given an equation which represents the energy levels E of an optical electron, and the author shows that an equation given by him can represent the case of the energy levels of the nucleus. The equation is shown to hold for a number of radioactive substances. The author writes down the radial component of a wave equation, which has two sets of eigenvalues corresponding to the two equations mentioned above; one set holds for an electron in the optical levels, and the other for one in the nuclear levels. The equation will also give the energy values for an α-particle in the nucleus, by assigning the correct mass to the particle, and remembering the difference in the electrical charges of electrons and α-particles. A number of other interesting results follow from the theory. H. N. A.

894. Theory of Effect of Resonance Levels on Artificial Disintegration. N. F. Mott. *Roy. Soc., Proc.* 133. *pp.* 228–240, *Sept.* 1, 1931.—As pointed out by Gurney, the lighter nuclei may have virtual energy levels which are not occupied by α-particles. Calculations are made of the effects which these resonance levels may have on artificial disintegration and anomalous scattering. The wave-mechanical calculation is first carried out for the case when the α-particle has insufficient energy to eject or excite a proton. In this case one would only observe anomalous scattering, and a formula for the ratio of this scattering to the classical scattering is derived. The case in which a proton may be ejected is next treated. Here an upper limit to the effective cross-section of the atom for the capture of an α-particle, $a(\mathrm{E})$ is calculated. $a(\mathrm{E})_{\mathrm{max.}} = \lambda^2/4\pi$, where λ is the wave-length of the α-particle. Only in the circumstance that the interaction energy between the α-particle and proton is small will $a(E)$ exhibit a pronounced maximum. The experiments of Pose, who finds sharp resonance levels in Al under conditions in which the interaction energy between α-particle and proton is large are difficult to explain. From Pose's observations and the derived expression for $a(E)_{\max.}$, an estimate of the minimum breadth of the energy levels of the Al nucleus is made and found to be about 2×10^5 electron volts. J. E. K.

895. Recording of α-Ray Spectra of very Small Intensity. G. Stetter and R. Premm. *Akad. Wiss. Wien, Ber.* 140. *2a.* 7. *pp.* 579–584, 1931.—For picturing the spectra of corpuscular rays the photographic method has long been used. When small amounts of the rays, however, are dealt with as in experiments on atom disintegration the result is apt to be a uniform grey patch, the plate being very sensitive to other influences. Other methods have been tried, including those depending on chemical processes, and next a biological method was employed which made use of the change of living cells under the action of α-rays. For this purpose fungus and spore were employed whose capability of germination is taken away or much lessened by exposure to α-radiation. Since both these ways did not give satisfactory results, the object in view was attained by the use of photographic impressions of a series of points or dots. These could even under general blackening be recognised and numbered. J. J. S.

896. Mass Spectra of the Positive Rays of ThC. R. Premm. *Akad. Wiss. Wien, Ber.* 140. *2a.* 7. *pp.* 585–597, 1931.—The positive radiation of ThC was investigated by a new arrangement for obtaining mass spectrographs. For the first time the α nature of the normal radiation of ThC ($R_{15,760} = 8 \cdot 6$ cm.) was established by simultaneous electric and magnetic deflection. The mass spectrogram was obtained by perpendicular incidence of the radiation on a photographic film. Likewise for the first time a mass spectrum of the numerous group of the wide-range radiation of ThC was obtained, *viz.*, that with $R = 11 \cdot 5$ cm. This was carried out, on account of the small number of the particles, by a series of point impressions on a special film made for this purpose. Finally, the relation of wide-range to the normal α-rays of ThC ($R_{15,760} = 8 \cdot 6$ cm.) was established, which was, under the given conditions, found to be in good agreement with the value obtained by K. Philipp. J. J. S.

897. Magnetic Spectrum of α-Rays from the Active Deposit of Actinium. (Mme.) P. Curie and S. Rosenblum. *J. de Physique et le Radium,* 2. *pp.* 309–311, *Oct.,* 1931.—Preparing the active deposit (AcB + AcC + AcC″ + AcC′) from the actinon from $1 \cdot 1$ gm. La_2O_3 containing $0 \cdot 3$ mg. Ac, and employing a field of 24,000 gauss, the method previously described [see Abstracts 1302 and 3857 (1931)] gives two intense lines from AcC . . . α_{AcC} (formerly denoted as α) and α_1, and one weak line from AcC′ . . . $\alpha_{\text{AcC}'}$ (formerly α_2), with velocity ratios $V_{\alpha 1}/V_{\alpha\text{AcC}} = 0 \cdot 973$, and $V_{\alpha\text{AcC}'}/V_{\alpha\text{AcC}} = 1 \cdot 062$ ($V_{\alpha\text{AcC}}$ being $1 \cdot 782 \times 10^5$ cm./sec.), and energy difference $\alpha_{\text{AcC}} - \alpha_1 = 352$ *e*KV. If there are other rays their intensity is $\not>$ 1/5000 of that of α_{AcC}. C. A. S.

898. Ionisation of α-Rays. G. Schmidt. *Zeits. f. Physik,* 72. 5–6. *pp.* 275–292, *Oct.* 21, 1931.—With an apparatus which in principle is the same as Millikan's condenser the ionisation curve of the α-rays of polonium was obtained. In this apparatus a drop of oil by its transformations per unit of time serves to measure the intensity of ionisation at various parts of the course. The observed frequency of discharge of the oil drop is compared with the total number of ions which under the actual conditions of the experiment can be led through the electric field at the drop. From the percentage of the doubly-charged ions appearing the relative probability of ionisation for the polonium α-rays can be obtained in the K level for air. J. J. S.

899. Transition Probabilities of Excited Nuclei. M. Delbrück and G. Gamow. *Zeits. f. Physik,* 72. 7–8. *pp.* 492–499, *Oct.* 28, 1931.—An excited nucleus can alternatively send out a wide-ranging α-ray, a secondary β-ray, or a γ-ray. Upper and lower limits for the probabilities of these processes are theoretically deduced. From these are then obtained upper and lower limits for the relative numbers of the emitted, α-, secondary β-, and γ-rays. These are compared with the numbers known from experiment, and in no case are there found contradictions between theory and experiment. J. J. S.

900. Excitation of the Fluorine Nucleus to Produce the Emission of H-Rays. H. Pose. *Zeits. f. Physik,* 72. 7–8. *pp.* 528–541, *Oct.* 28. 1931.—Describes experiments in which fluorine was bombarded with α-rays from polonium. A plate of CaF_2 was employed. Three groups of H-particles of different ranges were measured. Two of these were produced only by α-rays within a small interval of range. The third group was produced by α-rays within a large interval of range. The behaviour of the first two groups is explained, in terms of Gamow's quantum theory of the atomic nucleus, as a resonance effect between the energy of the α-particle and the nuclear eigenvibrations. The third can be explained as a normal excitation process, in which the α-particle becomes embodied in the atomic nucleus. H. N. A.

901. Absorption of Penetrating γ-Rays by 12 to 30 cm. of Lead. A. Piccard, E. Stahel and F. Dony. *Comptes Rendus,* 193. *pp.* 526–527, *Oct.* 5, 1931.—The absorption of γ-rays from RaC by thick lead screens is compared with that by a standard filter 1·5 cm. thick. Two independent sets of readings show that the absorption relative to that of the filter is independent of the thickness. No trace of ultra-penetrating radiation could be detected. This result is opposed to the supposition that cosmic radiation originates in ordinary radioactive transformation, since no γ-rays were found at an altitude of 16,000 m. No selective separation of the more penetrating components as a function of thickness was observed. C. B. A.

HEAT.

902. New Method of Determining the Thermal Conductivity of Metals. F. Gabler. *Akad. Wiss. Wien, Ber.* 140. 2*a*. 7. *pp*. 433–451, 1931.—A modification of Despretz's method is described, which avoids many of the uncertainties in the assumption of that method regarding heat loss. In a series of experiments the extreme dispersion of the values for nickel (a poorly conducting metal) was 3½ %, whilst for copper it was 1½ %. The mean values are in good agreement with the accepted values for these metals. J. H. A.

903. Change of Thermal Conductivity of Gases in Electrostatic Fields. W. Bonwitt and G. Groetzinger. *Zeits. f. Physik*, 72. 9–10. *pp*. 600–612, *Oct*. 30, 1931.—The influence of electrostatic fields of up to 4000 volts on the heat conductivity of various gases and vapours at pressures between 10 and 760 mm. has been studied. With air, nitrogen and carbon dioxide the effect is very small, but with substances such as chloroform, ammonia, acetone, and ethyl chloride, which have appreciable electric moments, the effect is considerable and increases with the electric moment of the molecule. In all cases the conductivity increases when the field is applied, the maximum increase of heat transfer in unit time interval being 0·82%. H. F. G.

904. Natural Observation Limit of Radiometric Measurements. C. H. Cartwright. *Physics*, 1. *pp*. 211–229, *Oct*., 1931.—The sensitivities of thermocouples, radiomicrometers, bolometers, expansiometers and radiometers are compared by determining the minimum amount of energy that can be detected by a single observation. The instruments are considered to be critically damped and the accuracy of the measurements to be limited by the Brownian motion fluctuations of the measuring device. A detectable deflection is arbitrarily taken as four times as large as the Brownian motion fluctuations. The theoretical considerations are included for their generality or for their direct bearing on the practical design and use of the instruments. A thermocouple with a galvanometer or a radiomicrometer is the most sensitive of the measuring instruments considered. By a single observation with a galvanometer of 1 sec. period, 3×10^{-11} gm. cal./sec. falling on a thermocouple receiver 1 mm.^{2} should be detected. A complete theory of the vacuum bolometer is presented. The ideal sensitivity of a vacuum bolometer is approximately the same as for a thermocouple, but practical difficulties make the bolometer less sensitive. The valve is less sensitive than a galvanometer for use with a thermocouple or bolometer. A thin bimetallic receiver would not be as sensitive as a thermocouple for making accurate radiometric measurements. A vacuum thermocouple is about twenty times more sensitive than a radiometer mostly because the gas pressure that is needed for the action of the radiometer only allows the receiver to be heated about 1/10 as high as a vacuum thermocouple receiver. The sensitivity of a critically damped galvanometer or radiometer, limited by the Brownian motion, is proportional to the square root of the period. AUTHOR.

905. Radiation of a Filament Surrounded by an Incandescent Tube. P. Clausing. *Rev. d'Optique*, 10. *pp*. 353–362, *Oct*., 1931.—Mathematically examines the exchange of energy between a filament, a tube surrounding the filament, and the intervening space, the filament and the tube being considered incandescent. The case of a filament placed inside the kathode for indirect heating is particularly considered, as is the case of a kathode surrounded by an anode, both being comparable in temperature. These correspond to a filament eccentric, but parallel to the axis of the tube and to a filament coaxial with the tube respectively. Finally, the anode is assumed to be perforated, a numerical example being given to illustrate the effect of the perforation of the anode on the temperatures. R. C. F.

906. Thermocouples whose Elements are Longitudinally and Transversely Magnetised Ferromagnetic Substances. S. Seass. *Phys. Rev.* 38. *pp.* 1254–1257, *Sept.* 15, 1931.—A ferromagnetic wire is bent at right angles to form a square **U**-shaped conductor. If the two bends are kept at different temperatures and the section between the two corners is magnetised transversely, while the portions leading from the right angles are longitudinally magnetised, an e.m.f. is set up between the bends. In the following paper the values of this e.m.f. for different magnetic fields are shown. Also, the relations between this effect, discovered by Thomson in 1856, and an effect discovered by v. Ettingshausen and Nernst, nearly thirty years later, are indicated. AUTHOR.

907. Discontinuities at the Melting Point of Bismuth. W. L. Webster. *Roy. Soc., Proc.* 133. *pp.* 162–172, *Sept.* 1, 1931.—Experiments were made to account for the cracks observed in bismuth crystals and to endeavour to find the supposed cubic modification. The magnetic discontinuity was determined at the melting point, and also the solid-liquid transition. The results show that the temperature of emission of the latent heat of fusion, of the acquisition of rigidity, and of the anomalous diamagnetic discontinuity coincide within an experimental error of 0·3° C. An alternative reason for the cracks is proposed, as the existence of the cubic phase is improbable. F. J. B.

908. General Theory of Boiling-Point Rules. T. S. Wheeler. *Phil. Mag.* 12. *pp.* 685–689, *Sept.*, 1931.—The paper correlates a number of well-known boiling-point rules by exhibiting them as particular cases which follow from certain quite general formulæ for vapour pressure as a function of temperature. J. H. A.

909. Adiabatic Calorimetry. S. W. Parr and W. D. Staley. *Indust. and Engin. Chem.* 3. *pp.* 396–397, *Oct.* 15, 1931.—The paper is concerned with the radiation correction in calorimetry, and especially with its reduction by means of a vacuum jacket. The use of a vacuum jacket has been criticised by some workers [see Abstract 1317 (1931)], but the present authors believe that, with proper precautions to ensure homogeneity of the temperature of the environment of the calorimeter, it can be used satisfactorily L. G. C.

910. Specific Heats of Air, Oxygen and Nitrogen from 20° to 370° C. P. S. H. Henry. *Roy. Soc., Proc.* 133. *pp.* 492–506, *Oct.* 1, 1931.—An account of improved apparatus and technique for the continuous flow method for comparing the specific heats of gases described previously by the author with Blackett and Rideal [see Abstract 2234 (1930)]. More uniformity is obtained in the temperature surrounding the tube of the calorimeter, the construction of which is given in detail. Instead of measuring thermal e.m.f.'s by galvanometer deflections, a potentiometer method is used, whereby the greater parts of them are balanced out and the small differences only read on the galvanometer, thus increasing sensitivity of the latter and enabling slower rates of gas flow to be employed. Double glands are fitted to the pump, eliminating leakage or contamination of gas, and automatic control of the pumping speed and heating current is effected. These experimental details are fully described. Results obtained from room temperature up to 370° C. for air, nitrogen and oxygen, and compared with theoretical and otherwise experimentally obtained values. They agree within the limits of experimental error. A final table records the collected data of the work in giving the smoothed values of C_v in cal. per gm. molecule per ° C. for the three gases above mentioned over the temperature range indicated. S. G. B.

911. Heats of Vaporisation of Organic Compounds. J. H. Mathews and P. R. Fehlandt. *Am. Chem. Soc., J.* 53. *pp.* 3212–3217, *Sept.*, 1931.—The original apparatus and method [see Abstract 1393 (1926)] have been modified with the objects principally of reducing the quantity of liquid required for a determination and of enabling the vaporiser coil to be thoroughly dried before each series of observations; the latter improvement allows of even boiling without superheating, and hence regular resistance readings on the vaporiser coil. The latent heats of vaporisation of twenty-two organic compounds have been determined.

H. F. G.

912. Vapour Pressures and Latent Heats of Vaporisation of Methylamine. A. W. Hsia. *Zeits. f. techn. Physik*, 12. 11. *pp.* 550–551, 1931.—The results of a new determination of the vapour pressures of methylamine show a slightly larger variation of pressure over the range − 77·1° to 9·2° C., than has previously been observed. The boiling point at normal pressures, *viz.*, − 6·45° C. is also lower than that found in previous determinations, which have given values ranging from − 7·5° to − 6·6° C. With the aid of the specific volumes of the liquid phase, taken from the work of Felsing and Thomas, and of Clapeyron's equation, a list of latent heats of vaporisation at different temperatures is calculated. J. P. A.

913. Effect of Intensive Drying on Rate of Distillation and Vapour Pressure of Ethyl Bromide. J. W. Smith. *Chem. Soc., J. pp.* 2573–2583, *Oct.*, 1931.—The time to distil a definite quantity of ethyl bromide from a vessel at one temperature to a second vessel at another temperature has been measured. It increases systematically as the time of contact between the liquid and resublimed P_2O_5 in an exhausted and dried apparatus is lengthened. There is no corresponding change in the vapour pressure of ethyl bromide after intensive drying. The results are interpreted as suggesting that intensive drying does not change the internal equilibrium between various species of molecules; the probability is rather that some type of nuclei disappears during the drying process.

J. H. A.

914. Economy of Time in Fractional Distillation. D. F. Stedman. *Canad. J. of Research*, 5. *pp.* 455–465, *Oct.*, 1931.—The mathematics of fractional distillation of ideal mixtures has been condensed, so that the most economical "reflux ratio" for any such mixture may be decided at once. Particular use is made of the "critical reflux ratio" for any mixture, above which even an infinite column cannot obtain complete separation; and the relation of this critical value to the most economical value for any particular case is given. Some of the conclusions with respect to the infinite column were tested by means of a mixture of methyl and ethyl alcohols using a particularly efficient column. It was found that the vapour produced in the still contained slightly more than the theoretical amount of methyl alcohol, and the magnitude of such error is illustrated from previous work on glycerin solutions [see Abstract 2150 (1928)]. The results are given in the form of a graph of the "critical reflux ratio" for the case where the most volatile constituent boils at 100° C., and the difference between the boiling points varies from 0·25° to 32° C., the concentration of the most volatile constituent also being included from 0·001 to 1·0. A table of correction factors is also given, showing the factor by which the "critical reflux ratio" should be varied to produce the greatest economy of time for any particular case. AUTHOR.

915. Determination of Osmotic Pressure by Isothermal Distillation. M. Ulmann. *Zeits. f. phys. Chem.* 156. *Abt. A.* 5–6. *pp.* 419–434, *Oct.*, 1931.—Osmotic pressures of aqueous solutions of glucose, saccharose and raffinose are measured by the method of isothermal distillation. The porous plate which allows distillation from a water column is composed of sintered glass, from which the air may be pumped with comparative rapidity. Experimental arrangements for introducing the water and the solutions are carefully devised to preclude uncontrollable temperature changes. The osmotic pressure is equal to the height of a mercury column after a very long period of distillation; but time is greatly economised by plotting a rectilinear graph between height of the column and the rate of distillation, and extrapolating. Results are in accordance with previous observations by other methods. J. P. A.

916. General Equations of Energy and Entropy of Gases. T. C. Huang. *Phys. Rev.* 38. *pp.* 1385–1386, *Oct.* 1, 1931.—From Huang's general equation of entropy [see Abstract 3153 (1931)] there is deduced a general adiabatic equation,

$$\int\psi(v)dv - \int\frac{\partial F}{\partial T}dv + \int c_{va}\frac{dT}{T} = \text{const.}$$

for any gas of the type, $p = T\Psi'(v) - \Phi(v) - F(v, T)$. The result is tested satisfactorily with a perfect gas and gases obeying van der Waals' and Beattie-Bridgeman's equations of state. AUTHOR.

917. Entropy of Polyatomic Molecules. D. S. Villars. *Phys. Rev.* 38. *pp.* 1552–1564, *Oct.* 15, 1931.—By counting the total number of completely antisymmetric eigenfunctions which can be formed from the rotational states, the *a priori* probabilities of the different symmetry varieties of ammonia (nuclear doublet and quadruplet) and of methane (nuclear singlet, triplet and quintet) are derived and used to compute the corresponding entropies at 298·1° K. The relative proportions of the different varieties at high temperatures are found to be equal for ammonia and in the ratio of 2 : 9 : 5 for methane (respectively). The absolute entropy of the mixture of the different forms of ammonia is calculated to be 51·5 cal. deg.$^{-1}$, the virtual entropy (the absolute minus the nuclear spin minus the frozen rotational entropy) 44·1; the absolute entropy of methane 50·1, and its virtual entropy 44·2 cal. deg.$^{-1}$. AUTHOR.

SOUND.

918. Numerical Relations of Musical Scales. H. Hofbauer. *Pont. Accad. Sci., N. Lincei, Atti,* 84. *pp.* 587–592, *June* 21, 1931. *In German.*—A geometrical representation of the scale as a series of functions of the small whole tone with the aid of the " golden section " [see Abstract 2375 (1931)]. E. E. F. d'A.

919. Sound Field Near an Oscillating Plane Disc. R. Ruedy. *Canad. J. of Research,* 5. *pp.* 297–301, *Sept.,* 1931.—With the aid of recent theories (H. Stenzel, N. W. McLachlan, H. Backhaus [see Abstract 3504 (1930)]) the velocity potential and pressure distribution at points in the field of vibrating solid discs of 1 to 20 cm. diameter are calculated for a number of frequencies of practical importance. The graphs drawn from these values apply also to very high frequencies, but smaller discs (1 to 20 mm.). They illustrate the gradual transition from spherical distribution to directed transmission. AUTHOR.

920. Struck String Theory. K. C. Kar and M. Ghosh. *Phil. Mag.* 12. *pp.* 676–685, *Sept.,* 1931. *Zeits. f. angew. Math. u. Mechanik,* 11. *pp.* 361–372, *Oct.,* 1931. *In English.*—A purely theoretical paper extending the method of two previous papers [see Abstract 2611 (1930)] to a more general case of a damped string struck near the middle by a yielding hammer, under such conditions that the duration of the impact is brief. An extension of the work is promised, taking into account the many reflections which occur when the impact is near an end of the string. W. H. GE.

921. Organ Pipes. L. N. Leet. *Acoustical Soc. of America, J.* 3. *Part* 1. *pp.* 207–221, *Oct.,* 1931.—A general description of the various shapes, sizes and materials used in organ pipes. Diagrams are given, but there is very little reference to the physics of the problems involved. W. H. GE.

922. Strike Note of Bells. A. T. Jones and G. W. Alderman. *Acoustical Soc. of America, J.* 3. *Part* I. *pp.* 297–307, *Oct.,* 1931.—Continues the study of the strike note of bells [see Abstract 564 (1931)]. This note, which is the dominating tone for the bell when sounded in fairly rapid succession with other bells, does not appear to be objectively present in the air. The fifth partial of a bell is prominent immediately after the bell is struck, but the strike note is usually judged to be an octave lower than the fifth partial. For a number of bells the frequencies of the fifth, seventh and tenth partials were determined with the aid of tuning forks, and it was found that the first order difference tone from the fifth and seventh partials deviated from the strike note too much to justify a difference-tone theory of the strike note. The intensities of the partials of four bells were investigated with the aid of a microphone and oscillograph, and it was found that the fifth partial is at first the most prominent, and that the third and seventh come next in intensity. The fifth and seventh are rapidly damped, and the third dies out more rapidly than the first. Measurement of the duration of the impact between bell and clapper, using the oscillograph method, showed that the blow lasts for about half the period of the fifth partial. W. H. GE.

ELECTRICITY AND MAGNETISM.

ELECTROSTATICS, TERRESTRIAL ELECTRICITY AND MAGNETISM.

923. Dielectric Constants of Mixtures of Ethyl Alcohol and Water. J. Wyman, Jr. *Am. Chem. Soc., J.* 53. *pp.* 3292–3301, *Sept.*, 1931.—Values of the dielectric constant of alcohol-water mixtures from -5 to 40° have been determined for the entire range of composition. The method employed was based on the determination of the natural period of a small all-metal circuit completely immersed in the medium. The frequency varied from $2\cdot15 \times 10^8$ to $4\cdot10 \times 10^8$ ($\lambda = 3\cdot971$ and $7\cdot302$ m. respectively). In the case of pure alcohol the dielectric constant was shown to be independent of frequency between $\lambda = 3\cdot972$ and $17\cdot005$ m. A comparison is given of the data now obtained and that already published. H. H. Ho.

924. Temperature Dependence of the Dielectric Polarisation of Certain Benzene Derivatives. E. Bretscher. *Phys. Zeits.* 32. *pp.* 765–773, *Oct.* 1, 1931.—The author discusses assumptions for a method of measuring dielectric polarisation at different temperatures, and describes a special experimental arrangement for the determination of the dielectric constant. Data are then given for the polarisation of diethyl-phthalate and of catechol diethyl ether dissolved in decalin and in perchlorethylene respectively, which are subsequently discussed in connection with the Debye law. H. H. Ho.

925. Rôle of the Dielectric Constant, Polarisation and Dipole Moment in Colloidal Systems. W. Gallay. *Kolloid Zeits.* 57. *pp.* 1–7, *Oct.*, 1931.—This paper deals with the dielectric and related magnitudes, such as density, molecular weight and refractive index in polymeric series of substances possessing high molecular weights, *e.g.*, polyindenes and polystyroles. In both these series the dielectric polarisations possess a maximum in the highly dispersed colloidal region. The refraction polarisation possesses a minimum in the same region. The value of the dipole moment increases in both series with increasing molecular weight. A short theoretical discussion of the data is included. H. H. Ho.

926. Dipole Moments of Homologous Alcohols, Esters and Ketones. K. L. Wolf and W. J. Gross. *Zeits. f. phys. Chem.* 14. *Abt.B.* 5. *pp.* 305–325, *Oct.*, 1931.—The dipole moments now recorded show that in homologous series their magnitudes alternate with the number of carbon atoms, and this property is briefly discussed in relation to other alternating regularities, such as refraction, saponification and dissociation constants, heats of combustion, compressibilities, melting points, solubilities, densities, etc. Finally, a special construction is described for the measurement of the dielectric constant which is based upon a suspension method and affords particular advantages. H. H. Ho.

927. Dipole Moments of Esters with Chain and Cyclic Carbon Residues. H. L. Donle. *Zeits. f. phys. Chem.* 14. *Abt.B.* 5. *pp.* 326–338, *Oct.*, 1931.—Measurements are recorded and discussed for the dipole moments of esters with chain and ring residues, together with data for aromatic esters. Based on these data an angular value is derived for the position of the moments in the aliphatic benzoic acid esters, and in the phenyl esters relative to the benzene ring, and then employed for the calculation of the moments of disubstituted benzene derivatives. H. H. Ho.

928. General Formula for the Calculation of Dipole Moments. O. Fuchs. *Zeits. f. phys. Chem.* 14. *Abt.B.* 5. *pp.* 339–345, *Oct.*, 1931.—The author derives a formula which permits the dipole moments of polysubstituted molecules to be calculated from the moments of the monosubstitution products, even when the substituents are freely rotatable groups. H. H. Ho.

929. Dipole Moments of the Chlorotoluenes and Toluonitrile. K. L. Wolf and H. G. Trieschmann. *Zeits. f. phys. Chem.* 14. *Abt.B*, 5. *pp.* 346–349, *Oct.*, 1931.—Measurements of the dipole moments of *o* – ($1{\cdot}32_4 \pm 0{\cdot}02$), *m* – ($1{\cdot}79_4 \pm 0{\cdot}04$), and *p* – ($1{\cdot}88_1 \pm 0{\cdot}015$) chlorotoluenes and of *o*-toluonitrile ($3{\cdot}77_5 \pm 0{\cdot}01$) are recorded, which agree with the theoretical values. H. H. Ho.

930. Electric Moment of Hydrobenzoin and of Isohydrobenzoin. O. Hassel and E. Naeshagen. *Zeits. f. phys. Chem.* 14. *Abt.B.* 3–4. *pp.* 232–236, *Oct.*, 1931.—The electric moment of hydrobenzoin as determined at 60° C. and at 18° C. is $2{\cdot}3 \times 10^{-18}$, and of isohydrobenzoin $2{\cdot}7 \times 10^{-18}$ e.s.u. H. H. Ho.

931. Electric Moments of the Halogeno-Nitrobenzenes. H. Lütgert. *Zeits. f. phys. Chem.* 14. *Abt.B.* 5. *pp.* 350–358, *Oct.*, 1931.—Comprehensive data are given for the total polarisation of the isomeric chloronitro-, bromonitro- and iodonitro-benzenes measured at two temperatures. Based upon these data the atomic polarisations have been approximately estimated and the electric moments calculated. H. H. Ho.

932. Measurement and Indication of Atmospheric Electric Potential Gradient. C. W. Lutz. *Gerlands Beitr. z. Geophys.* 31. 4. *pp.* 398–425, 1931.—A new form of Ra-Th collector is used for the absolute measurement of the atmospheric electric potential gradient, and it is tested first in artificially produced electric fields. Errors due to the flow of air past the collector are investigated, and its most suitable size and shape are found. Errors in the field due to the presence of the observer are determined. Tests were next made in natural electric fields and the results obtained with the new collector compared with those from a Hoffmann water dropper and a Benndorf electrometer. The apparatus is light, easy to handle, and insensitive to wind changes, inclination and oscillation. A simple small static electrometer is next described, consisting essentially of a gilt quartz thread stretched in an electric field between two plates; and apart from its use in the laboratory it is suitable for atmospheric electric measurements in the free air, in aircraft and parachutes. Finally, particulars are given of a smaller light portable photographic recording apparatus, which can be used for other suspension instruments, such as an electrometer, galvanometer or oscillograph, or with small changes for other reflecting instruments. R. S. R.

933. New Experiment Bearing on Cosmic-Ray Phenomena. L. M. Mott-Smith and G. L. Locher. *Phys. Rev.* 38. *pp.* 1399–1408, *Oct.* 15, 1931.—This new experiment consists in combining a Wilson cloud expansion apparatus with Geiger-Müller electron-counters in a manner which allows the simultaneous study of individual cosmic-ray particles by the two methods. Its purpose was to see whether the coincidence effect in electron-counters is actually caused by the passage of an ionising particle through them as has been generally assumed. This was considered desirable because it was felt that the several conflicting cosmic-ray experiments could perhaps be more satisfactorily explained by assuming the coincidences to be produced by photons. In this work a series of expansion photographs was taken under experimental conditions which allowed a definite correlation of an ion-track appearing in the expansion chamber with a discharge of a Geiger-Müller counter. It was found that the discharges of a counter due to cosmic radiation are accompanied by ion-tracks resembling those due to fast β-rays from radioactive sources. This result means that, in accord with previous beliefs, the coincidence effects are caused by ionising particles. The best assumption we can make at present appears to be that these are high-energy electrons. The possibility that these effects are due to photons appears to be excluded, so that the reconciliation of the conflicting experimental data in this field will have to follow other lines. AUTHORS.

934. Transition Effect in Cosmic Radiation. H. Schindler. *Zeits. f. Physik*, 72. 9–10. *pp.* 625–657, *Oct.* 30, 1931.—Investigation was made of the behaviour of the ultra-radiation which within a solid angle of ± 30° fell upon various substances (Hg, Pb, Fe, Al, H_2O, paraffin). With this object in view a special differential apparatus with two ionisation chambers was constructed, which has the advantage that the measurements of all oscillations of the cosmic radiation, apart from statistic, are approximately independent, since these oscillations occur equally in both chambers. With the apparatus the usual oscillation curves for the above-named substances were next taken (with principal curves indicated). It is established that these chief curves, if the weakening thickness of layer is correlated for equal electron thickness for the various substances, do not coincide. They arrange themselves, for thicknesses of layer which are greater than 4 cm. of lead, according to the atomic weight. Substances of higher atomic weight have a greater weakening effect. The commencement of the chief curve exhibits a peculiarity in which it quite departs from the course of an ordinary absorption curve. The first centimetre Pb-equivalent scarcely diminishes the ionisation of the cosmic radiation (except for water and paraffin); with Fe, Pb and Hg there occurs in the first place an increase of the ionisation. It is shown that this effect is not due to radioactive contamination of the absorbing medium, and thus must be ascribed to the cosmic radiation itself. Besides the chief curve a series of so-called transition curves were measured. These are got when, first of all through a definite layer of medium 1 and then afterwards through a medium 2, weakening of the radiation takes place. It is found that such a transition curve, proceeding from the chief curve of the medium 1 after a certain thickness of the medium 2, attains again the chief curve of medium 2. Of importance appears to be the fact that the affixing of Fe, Al or paraffin behind a layer of Pb of more than 10 cm. does not enfeeble the ionisation action, but rather strengthens it. J. J. S.

CURRENT ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM.

935. Influence of Tension and Compression on the Specific Resistance of Single Crystals of Bismuth. O. Trapeznikowa. *K. Akad. Amsterdam, Proc.* 34. 6. *pp.* 840–843, 1931. *In German.*—Contrary to the results of Kapitza, compression and tension have no influence on the specific resistance of a single crystal of bismuth. F. J. W.

936. Possible Allotropic Modifications of Semi-Conductors. A. Schulze. *Zeits. f. Metallkunde,* 23. *pp.* 261–264, *Sept.,* 1931.—Previous work on the elements Si, Ge, Ti and Zr has led to the conclusion that these so-called semi-conductors change from one form to another at certain definite temperatures, the electrical resistance changing suddenly. The temperature coefficient has in the past been found to be negative, so that they did not appear to behave like metals. Gudden has, however, suggested that this behaviour is due to the fact that the resistance observed has been mainly due to boundary layers between the crystallites, oxide and other impurity films. The author has investigated the matter, and finds, particularly for Si, that when pure material, and particularly pure monocrystals, are used there is no evidence of polymorphism, either in the electrical resistance or the thermal expansion. Determination of the lattice constant at different temperatures leads to the same result. Bidwell has reached the same conclusion with regard to Ge from measurements of the electrical resistance. The same is true of pure Ti. Pure Zr also conducts like a metal; but according to Zwikker changes to a new form above 800° C. In all cases the temperature coefficients of the resistance are positive in the pure materials. H. N. A.

937. Theory of Metallic Contact. R. Holm. *Wiss. Veröff. a. d. Siemens-Konzern,* 10. 4. *pp.* 1–19, 1931.—A foreign layer in a contact causes, as a rule, a transition resistance far surpassing the extension resistance, and this is nearly proportional to the thickness of the layer. Where, however, a foreign layer only a few molecules thick may be assumed, there appear transition resistances which are smaller by several powers of ten than would be expected from proportionality to the thickness. It is possible that such " extended skins " play for the conducting electrons the easy rôle for penetrating potential surges. Yet it is probable that in the observations made the stretched skin material in the metal was pressed in so that " disturbed metallic " contact existed. The actual foreign layers could in general be frittered or caked (coherence effect) by field strengths of the order of magnitude of 10^6 V/cm. Therefore there exist in them small metallic bridges between the electrode surfaces whereby an improved conductivity comes into existence which lasts as long as the bridges remain intact. The frittering can develop into destructive penetration. The collision ionisation penetration is thereupon changed in nature. The principles for the calculation of the dimensions of the bridges are given. The resistance-tension characteristic of a virgin contact experiences a dissolution falling-off if the current raises the contact surfaces to the dissolution temperature. [See following Abstract.] J. J. S.

938. Metallic Contacts. R. Holm, F. Güldenpfennig, Else Holm, and R. Störmer. *Wiss. Veröff. a. d. Siemens-Konzern,* 10. 4. *pp.* 20–64, 1931.—An account of the experimental basis for R. Holm's theory of metallic contacts [see preceding Abstract], in which the results are given of observations on the contact of Ni — NiO against Au, Ni, or graphite, Ni flake against Au or graphite, Cu — Cu_2O against Au. In certain cases the dimensions of the caking bridges could be calculated. Their mechanical rigidity is what was expected. The thickness of the layers was estimated by means of observations on the interference colours. The formation of stretched skins and foreign layers at metal surfaces is followed up till contact. Various observations on the influence of contact pressure, as well as on the adhesion of contacts, are discussed. J. J. S.

939. Electrical Conductivity of Cuprous Oxide in Relation to Heating. F. Waibel. *Wiss. Veröff. a. d. Siemens-Konzern,* 10. 4. *pp.* 65–69, 1931.—Extraordinarily great variations in the electrical conductivity were manifested by cuprous oxide. The influence of heating on the conductivity was investigated in the region of temperature from 0° to 1050° with simultaneous change of the pressure of oxygen from 0 to 1 atmosphere. A remarkable temperature region was exhibited between about 450–550°. Long tempering in this region and very quick cooling produced a maximum conductivity. Upper limits of conductivity were measured up to about 70 ohm-cm. with material which initially had about 250 times the specific resistance. Long tempering above and below this range of temperature and cooling lessens the conductivities. The disparities in conductivity maximum increase with increasing distance from the 500° region. The effect of tempering from 500° downwards was independent of the oxygen pressure. Above 500° there came on with long full treatment with oxygen a strong increase of specific resistance which rose to about 10^7 ohm-cm. Parallel to the change of conductivity occurs a like change of the temperature coefficient. High specific resistance is connected with great temperature coefficients, and *vice versa.* Comment is made on the technical significance of the tempering. J. J. S.

940. Rectifying Action with Cuprous Oxide. F. Waibel. *Wiss. Veröff. a. d. Siemens-Konzern,* 10. 4. *pp.* 70–72, 1931.—The identity is established of the rectifying action of foreign contacts towards massive, etched cuprous oxide with that of naturally developed cuprous oxide towards the mother copper. The absolute magnitudes are also found. J. J. S.

941. Measurement of High Resistance by the Bridge Method. J. A. C. Teegan. *Phil. Mag.* 12. *pp.* 840–842, *Oct.*, 1931.—In the ordinary method of using a bridge, difficulty is experienced in measuring resistances greater than about 1 megohm on account of the small currents in the network. This difficulty may be overcome by using in place of the usual galvanometer a triode amplifier the grid and filament of which are connected to the usual galvanometer terminals. It is shown that this method extends the range to at least 3×10^8 ohms, and that results for the resistivity of xylol-alcohol mixtures may be obtained which agree with values obtained by other workers ($\rho = 0{\cdot}70 \times 10^7$ ohm). G. E. B.

942. Electrical Properties of Spectroscopically Pure Zinc Crystals. A. G. Hoyem. *Phys. Rev.* 38. *pp.* 1357–1371, *Oct.* 1, 1931.—A very accurate confirmation of the Voigt-Thomson symmetry relation has been obtained, the principal values of the Thomson coefficient being: $\sigma\perp = 0{\cdot}86 \times 10^{-6}$ cal./coul./deg., and $\sigma\| = 0{\cdot}34 \times 10^{-6}$ cal./coul./deg. The thermal e.m.f. of the same specimens of zinc against copper has been determined as a function of orientation throughout the temperature range

— 180° to 200° C. From these data the values of the Peltier and Thomson coefficients respectively, and the difference in principal Thomson coefficients have been computed as functions of temperature, by means of the relations given by the Kelvin thermodynamical theory of thermoelectricity. The predictions of the Kelvin theory regarding $\sigma\perp - \sigma\|$ are found to be in agreement with the direct determinations by Ware and the author. The Voigt-Thomson law is found to hold also in the case of thermoelectric power and the other thermometric properties to which it should apply. The dependence of resistivity on temperature has been investigated for the range $-170°$ to $25°$, the average value of the coefficient being $a = 4{\cdot}058 \times 10^{-3}$. Various qualities of zinc have also been examined in addition to the spectroscopically pure variety, and comparison data are included. H. H. Ho.

943. Hall Effect and Lattice Constants of Gold-Silver Alloys. L. S. Ornstein and W. C. van Geel. *Zeits. f. Physik*, 72. 7–8. *pp*. 488–491, *Oct*. 28, 1931.—For Au-Ag alloys with various proportions of the components, the Hall effect was measured as function of this proportion. The Hall coefficient shows in connection with the total composition of the alloy a course similar to that of the lattice constants as measured by Sachs and Weerts. There exists a linear connection between the Hall coefficient and the lattice constant. J. J. S.

944. Investigations with a Lenard-Coolidge Tube. W. Gentner. *Ann. d. Physik*, 10. 2. *pp*. 223–243, *July* 3, 1931.—Using a special Lenard-Coolidge tube, kathode rays of velocities up to 220 kV and great intensity are produced and transmitted outside the tube. Thus it is possible to measure the range in aluminium and its dependence upon velocity, of kathode rays faster than those previously examined yet slower than β-rays. Schonland's law, that the product of range and density of medium is constant, is proved to apply to air. Wilson's relation giving the range of electrons in air is supported by these measurements, but the constant for air in Whiddington's equation is found to be too great. A special concentrating coil is constructed, making it possible to intensify the central portion of the beam of rays. A special method of eliminating X-rays introduced into the beam by passage through a window in the tube is developed. N. D.

945. Products and Processes of Ionisation by Low-Speed Electrons. H. D. Smyth. *Rev. Modern Physics*, 3. *pp*. 347–391, *July*, 1931.—After a short historical introduction to the subject, the author describes three experimental methods with their objects and difficulties: (1) Method of unidirectional vapour stream, (2) differential pumping, (3) that of very low uniform pressure. Typical procedure and results are given for the case of hydrogen with an e/m curve for H, and ionisation potential curves. Effects of collision of the second kind (selective absorption) and the work of Harnwell, and of Kallmann and Rosen, are described, and also the effect of space charge. In the third part of the paper experimental results and their interpretation are dealt with in the case (1) of monatomic gases and (2) polyatomic gases, and, lastly, a summary is given of the object and results of the experiments described. That object is to determine the energies required for the production of different types of ion by electron impact. A good deal of light has been thrown on the processes of ionisation by electron impact at low voltages. One outstanding result is the infrequency with which dissociation accompanies ionisation. A second result of great interest is the observation of high-speed ions. The theoretical interpretation of the various ionisation potentials is considered to be fairly satisfactory, so far as it goes. The author judges that the emphasis in future work should be greatly changed. The study of fast ions, ionisation probabilities and of ionisation by means other than electron impact should be developed, and value is attached to the possible study of such negative ions as the H — observed only at a particular potential in water vapour, which is the most interesting of all recent results. J. J. S.

946. Gradual Change from Glow to Arc Discharge. J. Nikliborc. *Comptes Rendus, Polonaise,* 5. *pp.* 425–451, 1931. *German Abstract.*—Shows that it is possible, by increasing the pressure, to produce a gradual change from the glow to the arc discharge. A mercury lamp with an iron anode was used, with a 3000-volt d.c. dynamo. The mercury kathode surface was, at low mercury vapour pressures, completely covered with glow light, and less completely when the pressure increased. With constant distance between the electrodes the kathode glow shortened as the pressure increased, while the length of the positive column increased. A long series of measurements was made of voltages, currents, vapour pressures and distances between the electrodes, and graphs have been constructed showing the relation between the quantities. Reproductions of photographs of the discharge are given. It was found that the normal kathode drop diminishes regularly with increase in the vapour pressure in glow discharge, while it increases in arc discharge. It is also probable that at sufficiently high pressures there is only one form of discharge. H. N. A.

947. Control of the Glow Discharge at a Gauze Kathode by Means of a Third Electrode behind the Kathode. A. Güntherschulze and F. Keller. *Zeits. f. Physik,* 72. 3–4. *pp.* 133–142, *Oct.* 14, 1931.—An investigation was made of the behaviour of the currents and dark spaces in glow discharges between an anode and a gauze kathode in the rare gases He, Ne, A, Kr and the molecular gases H_2, N_2, O_2, when different potentials are applied to a third electrode behind the kathode, and also of the way in which the main discharge can be controlled by the subordinate one. With a high kathode fall of potential the main discharge is strongly affected when the third electrode is made positive with respect to the kathode. An astonishingly great effect is found in the neighbourhood of potential equality. With a small kathode fall the effect, on the other hand, is small. If the kathode and third electrode are directly connected with one another through an ammeter, part of the current of the main discharge flows through the gauze kathode to the third electrode. The current going to the third electrode in this case increases rapidly with decrease of gas pressure and with increase of the kathode fall up to 40 % of the main current. In the rare gases with small kathode fall it is appreciably greater than in the molecular gases. A. W.

948. Electro-Optical Shutter—Its Theory and Technique. F. G. Dunnington. *Phys. Rev.* 38. *pp.* 1506–1534, *Oct.* 15, 1931.—This paper records a development in the design of the single cell type of electro-optical shutter, together with a theory describing its action. Part I gives a description of the shutter, together with a method of observing simultaneously two stages of the phenomenon being studied. Part II gives the theory of shutter action. A condensed summary of the physical optics is followed by a development of the electric circuit theory which gives the manner of closing of the shutter when the leads to it are fairly short. The theory is illustrated by a series of numerical examples based on typical experimental conditions which show the effect of varying each controlling factor. The times required for closing (90 to 100 % transmission) are of the order of 4×10^{-9} sec. under favourable conditions. The necessity for a Kerr cell of small electrostatic capacity is shown. Part III gives three groups of experimental data which were obtained with the shutter in a study of spark breakdown: one indicates the time resolution attainable, another gives the total time lag in closing, and a third gives the change in this lag with certain conditions. The information of the second group combined with the theory yields the rate of fall of voltage across the controlling spark gap (static breakdown), a typical value being 14×10^{-9} sec. to fall to 20 % of the initial value (76 cm. Hg, 5 mm. gap). The theory and experimental data are found in complete agreement. An improved method is given for the determination of the correct damping resistance in the shutter circuit. Part IV gives a description and the factors considered in the design of the Kerr cells developed in the present study, also the essentials of the technique for their proper use. [See also following Abstract.] AUTHOR.

949. Optical Study of the Formation Stages of Spark Breakdown. F. G. Dunnington. *Phys. Rev.* 38. *pp.* 1535–1546, *Oct.* 15, 1931.—With the electro-optical shutter described [see preceding Abstract] a visual and photographic study has been made of the manner in which a static breakdown occurs in an air gap with an approximately homogeneous initial field. The study covered a range of pressures P from 20 to 76 cm. of Hg and gap lengths δ from 1·25 to 10 mm. The manner of breakdown for any condition can be told by the product ($P^{1/3}\delta$): for values less than 11·9 the breakdown starts at the kathode; for values greater than 11·9 there are two initial breakdown regions, one at the kathode and one out in the gap. The exact manner in which the breakdown proceeds is shown and discussed in detail. The effect of space charges on the time required for the gap to break down completely is also shown and a possible arrangement of space charges is suggested which would explain the phenomena observed. Data on the rate of voltage fall of the gap are given. AUTHOR.

950. Secondary Emission from Nickel by Impact of Metastable Atoms and Positive Ions of Helium. M. C. Harrington. *Phys. Rev.* 38. *pp.* 1312–1320, *Oct.* 1, 1931.—Experiments on the secondary electron emission from Ni electrodes due to bombardment by positive ions and metastable atoms in a helium discharge under conditions similar to those obtaining in a glow discharge are reported. The method of measurement is similar to that of Uyterhoeven and Harrington [see Abstract 251 (1931)]. The proportion of the measured current at the kathode which is carried by electrons is found to be 15 to 50 % depending on experimental conditions. Similarly the number of electrons per slow positive ion is found to range between about 8 and 20 %. The secondary electrons originate at the surface of the collector with about 15 volts maximum initial energy. AUTHOR.

951. Capture and Loss of Electrons by Helium Ions in Helium. P. Rudnick. *Phys. Rev.* 38. *pp.* 1342–1350, *Oct.* 1, 1931.—Mean free paths for capture (L_1) and loss (L_0) of electrons by helium ions in helium have been measured by a method whose chief novelty is the use of an ion source which gives quite strictly homogeneous velocities. In the range of velocities $0 \cdot 6 \times 10^8$ cm./sec. to $1 \cdot 0 \times 10^8$ cm./sec. L_0, reduced to 760 mm., is found to decrease from $21 \cdot 5 \times 10^{-4}$ cm. to $8 \cdot 6 \times 10^{-4}$ cm., and L_1 is practically constant at $1 \cdot 2 \times 10^{-4}$ cm. These results are compared with similar measurements by other observers, particularly with regard to the manner of dependence on velocity. The relation of the results to available information on ionisation and energy loss is discussed. AUTHOR.

952. Radiation from Probe Surfaces Bombarded by Electrons. F. L. Mohler and C. Boeckner. *Bureau of Standards, J. of Research*, 7. *pp.* 751–764, *Oct.*, 1931.—Metals in the form of small probe surfaces were held at a positive potential in the highly ionised region of a discharge—usually a cæsium discharge—and under intense electron bombardment emitted radiation. Spectrophotometric measurements of this radiation were made. Radiations at 7 volts from W, Al, Be and Au alloyed with Cs, Th and Pt were found to be similar in intensity and intensity distribution, the distribution being nearly constant between 2400 and 6400 Å. With Cu there is a pronounced increase in the red, and with Ag a tenfold increase between 3200 and 3600 Å. Above 6 volts this intensity distribution remains the same, while with lower voltages it drops almost linearly to zero with increasing ν, the threshold value of ν agreeing with the relation $h\nu = e(V + W)$, where W is $1 \cdot 45$ volts for tungsten and about 2 volts for Cu, Ag and Al. The equal energy spectrum common to all metals is probably analogous to continuous X-rays. The selective radiation of silver and copper may correspond to characteristic X-radiation. A. W.

953. Self-Maintained Neon Tube System. B. Decaux and P. le Corbeiller. *Comptes Rendus*, 193. *pp.* 723–725, *Oct.* 26, 1931.—A mathematical basis is given for the well-known effect of periodical illumination of a neon tube connected in series with a battery and a condenser, also for the arrangement where a condenser discharges slowly through a resistance in series with it and discharges rapidly through a neon tube mounted in parallel. A. W.

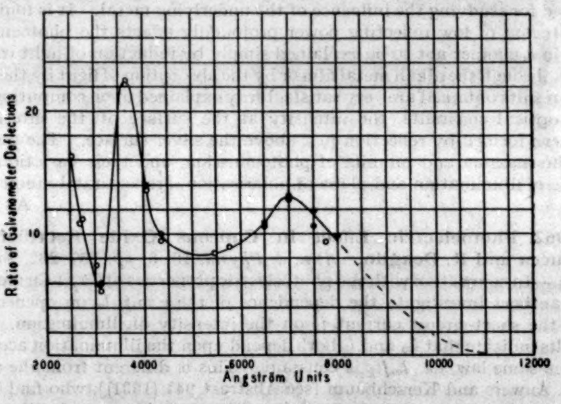
954. Diffraction of Kathode Rays by Thin Films. E. T. Jones. *Phil. Mag.* 12. *pp.* 641–657, *Sept.*, 1931.—Measurements of the diffraction rings formed when an electron stream passes through thin films of gold and of celluloid are given. The wave-length deduced from the rings in the case of gold is less than that calculated by wave mechanics for slow electrons. The opposite holds for high velocities. From the results for the celluloid films a suggested arrangement of molecules in the film is deduced. G. C. McV.

955. Diffraction of Electrons by a Single Crystal. G. P. Thomson. *Roy. Soc., Proc.* 133. *pp.* 1–25, *Sept.* 1, 1931.—Experiments are described on the diffraction of electrons by single crystals of copper or silver under a voltage of 30–50 kV [see Abstract 3640 (1930)]. They show a widely extended pattern of diffraction spots. The usual wave-theory can be extended to account for these patterns by supposing that the etched surface of the crystal is composed of a number of lumps of dimensions of the order of 10^{-6} cm. These may in some cases be the portions left between adjacent etching pits. No sign was found of reflection by "forbidden" crystal planes or of half-order spectra. Diffraction spectra are also produced from a cleavage surface of rock-salt, which also gives well-marked Kikuchi lines. The spectra of different orders are not evenly spaced. This seems to indicate an inner potential of about 10 volts for rock-salt. The depth of penetration of the rays is about 10^{-7} cm. In some cases the Kikuchi lines are represented by blackened strips. The cause of this is not explained. E. E. F. d'A.

956. Diffraction of Electrons by Single Crystals. J. J. Trillat and T. v. Hirsch. *Comptes Rendus*, 193. *pp.* 649–651, *Oct.* 19, 1931.—In the examination of thin gold leaf in a very narrow beam of 50 kV. electrons, diffraction patterns are obtained in certain places which must correspond to single crystals. These are orientated with the (100) axis perpendicular to the surface. Analysis of the diagrams indicates that the crystals in the leaf are slightly deformed. When the leaf is moved about in the beam, ordinary Debye-Scherrer rings are obtained. These are also obtained with the leaf stationary in a beam of X-rays. For certain purposes the electron beam has obvious advantages. C. B. A.

957. Electron Scattering at Single Crystals of Zinc. J. Lass and E. Rupp. *Ann. d. Physik*, 11. 5. *pp.* 611–622, *Oct.* 27, 1931.—The electron scattering at a single crystal of zinc may be arranged into two groups, the inner potential of the first group being zero and that of the second 15·3 ± 1 volts, provided half orders are allowed. F. J. W.

958. Spectral Sensitivity of Cæsium Oxide Photoelectric Cell. T. F. Young and W. C. Pierce. *J.O.S.A.* 21. *pp.* 497–501, *Aug.*, 1931.—Describes the construction of a photoelectric cell having a high sensitivity in the ultra-violet. The sensitive kathode is cæsium oxide deposited on silvered copper. The cell bulb is of quartz. The spectral sensitivity curve is shown in the figure. J. W. T. W.



959. Physico-Chemical Condition of the Metallic Surface during Selective Photoelectric Electronic Emission by Alkali Metals. R. Suhrmann. *Zeits. f. Elektrochem.* 37. *pp.* 678–682; *Disc.* 682, *Aug.-Sept.*, 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May*, 1931.—When a sensitive metallic surface is irradiated *in vacuo* with light of different wave-lengths, it is found in general that the photoelectric sensitivity steadily increases from the long to short waves. Some light metals, however, *e.g.*, the alkali metals with strontium and barium, behave differently. The photoelectric electronic emission of the latter increases to particularly high values in a special wave-length region, *i.e.*, the spectral distribution curve possesses a selective maximum. The present paper contains a detailed experimental study of potassium in this connection. The discussion concerns the method of evaluating the thicknesses of the layers employed. H. H. Ho.

960. Stop-Layer Photoelectric Effect. E. Duhme. *Zeits. f. Elektrochem.* 37. *pp.* 682–684, *Aug.–Sept.*, 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May,* 1931.—The present paper contains a description of this effect, taking as example the cuprous oxide stop-layer photoelectric cell. It is indicated that the effect is similar to a Becquerel effect of the first order without recourse to electrolytes, *i.e.*, the processes are purely electronic and not photogalvanic (*i.e.*, bound up with the transport of positive and negative ions). H. H. Ho.

961. Photoelectric Effect from Thin Films of Alkali Metal on Silver. H. E. Ives and H. B. Briggs. *Phys. Rev.* 38. *pp.* 1477–1489, *Oct.* 15, 1931.—The thin films of alkali metals which spontaneously deposit *in vacuo* on other metals have long been known to exhibit photoelectric effects which vary in amount and character, depending on the underlying material, but the exact nature of this dependence has been obscure. Silver, because of its region of exceedingly low reflecting power in the ultra-violet and the accompanying variation of optical constants, is exceptionally well suited for studying the influence of the underlying metal. It is found that the region of low reflecting power profoundly affects the photoemission, but in a manner not to be explained simply by reduction of light reflected back through the alkali metal film or by the absorption of light by the silver. The results obtained are very satisfactorily explained upon computing, from the optical constants, the intensity at the surface of the interference pattern formed by reflection just above the silver surface. The positions of the maxima and minima of photoemission, and their variations with angle of illumination and plane of polarisation, are accurately indicated.
AUTHORS.

962. Photoelectric Effect in Cuprous Oxide Rectifiers. E. Perucca and R. Deaglio. *Ann. d. Physik,* 10. 3. *pp.* 257–262, *July* 11, 1931.—In connection with the photoelectric properties of Cu_2O-Cu rectifiers, the authors investigate the dependence of the e.m.f. l_∞ on open circuit, and the short-circuit current i_k on the intensity of illumination. Their results indicate that l_∞ and i_k both depend upon the illumination according to the same law, *i.e.*, l_∞/i_k is constant. This is different from the results of v. Auwers and Kerschbaum [see Abstract 941 (1931)], who find i_k proportional to the intensity but not l_∞. Theoretical reasons for the effects obtained are suggested and are illustrated by a numerical example. [See following Abstract.] N. D.

963. Photoelectric Effect in Cuprous Oxide Rectifiers. O. v. Auwers and H. Kerschbaum. *Ann. d. Physik,* 10. 3. *p.* 262, *July* 11, 1931.—This note is in reply to work of Perucca and Deaglio [see preceding Abstract]. The reason for the different results obtained by those authors is ascribed to the degree of non-linearity of the stopping resistance used by them, which only amounted to 0·3 %, whereas the present authors had non-linearities of several per cent. Repetition confirms their previous results. N. D.

964. Cuprous Oxide Photoelectric Cells. L. Dubar. *Comptes Rendus,* 193. *pp.* 659–661, *Oct.* 19, 1931.—Studies the type of photoelectric cell consisting of a copper grid in intimate contact with the cuprous oxide layer. The photoelectric current in this case is in the opposite direction to that in cells in which the cuprous oxide is covered with a transparent layer of gold. The current is from the oxide to the copper. The voltage is from 7 to 15 microvolts at 25° C., decreasing reversibly to about a third at 60° C. E. E. F. d'A.

965. Photo-Ionisation of Cæsium Vapour. F. W. Cooke. *Phys. Rev.* 38. *pp.* 1351–1356, *Oct.* 1, 1931.—The photo-ionisation of cæsium vapour as a function of the wave-length of the light has been measured at low pressure. The curve has a maximum at the principal series limit, decreases to a minimum at 2800 Å. and rises again at shorter wave-lengths. The pressure was too low for the ionisation by line absorption to be observed. The absolute value of the atomic ionisation coefficient at the series limit was found to be 6×10^{-19}, in fair agreement with Mohler's value, which is $2{\cdot}3 \times 10^{-19}$. AUTHOR.

966. Increase of Photoelectric Current by Ionisation. P. W. Timofeev and N. S. Chlebnikow. *Zeits. f. Physik,* 72. 9–10. *pp.* 658–668, *Oct.* 30, 1931.—Show that the amount by which the current can be increased by the ionisation of the gas depends upon the shape and the dimensions of the cell. Argon gives a greater permissible magnification than neon. E. E. F. d'A.

967. Small Shot Effect in Quantum Mechanics. H. Fröhlich. *Zeits. f. Physik,* 71. 11–12. *pp.* 715–719, *Sept.* 26, 1931.—The equation obtained in quantum mechanics for the Richardson effect is slightly different from the classical equation based upon Maxwellian statistics. Since a Fermi gas differs from a Maxwell gas, we must expect the current variations also to be different from the classical ones. Calculation must take into account not only the elementary charge e, but also the smaller variations due to h, which may be described as the "small shot effect" (*Schrot Effekt*). The author calculates this effect, and shows that it lies below the limits of observation. E. E. F. d'A.

968. Shot Effect in Photoelectric Currents. B. A. Kingsbury. *Phys. Rev.* 38. *pp.* 1458–1476, *Oct.* 15, 1931.—The shot effect, as it occurs in a photoelectric current, has been used to secure an evaluation of the electron charge. A new and original method of amplifier calibration, which involved the use of a modulated light beam, simplified the measurements and the computation of the result. In the absence of space charge, the experimental value of the electron charge was $1{\cdot}61 \times 10^{-19}$ coulomb for a thermionic current, and about 25 % greater for a photoelectric current. It was found that the shot effect is enormously increased in photoelectric currents which are amplified by collision ionisation. Statistical variations which might be expected to occur in a beam of radiant energy could not be detected, since, within the limits of experimental accuracy, the shot effect in photoelectric currents was found to be independent of the frequency of the light producing electron emission. AUTHOR.

969. Contact P.D. between Iron and Nickel and Their Photoelectric Work Functions. G. N. Glasoe. *Phys. Rev.* 38. *pp.* 1490–1496, *Oct.* 15, 1931.—Specimens of electrolytic iron and electrolytic nickel were outgassed by intensive heat treatment in high vacuum and the contact potential difference between them measured by the Kelvin null method. An apparatus is described by means of which the photoelectric long wave limits could be determined on the same specimens and under identical conditions as used for the contact potential measurements. The photoelectric long wave limits were determined in one case by using filters in the path of the light and in a second case by the method of plotting the photoelectric sensitivity curves obtained using monochromatic illumination of the metals. The results remained unchanged between 300 and 750 hours of heating in the first case and between 400 and 600 hours in the second. The equilibrium value of the contact potential difference was Fe-Ni $+ 0\cdot21 \pm 0\cdot01$ volt. The photoelectric long wave limits determined by the second method were 2620 Å. ± 10 Å. for the iron and 2500 Å. ± 10 Å. for the nickel. The corresponding work functions are $4\cdot71 \pm 0\cdot02$ volts for the iron and $4\cdot93 \pm 0\cdot02$ volts for the nickel. Using the method published by Fowler, the work functions were $4\cdot77$ volts for the iron and $5\cdot01$ volts for the nickel. The difference in these work functions by either method is equal to the measured contact potential difference between the metals within the limits of error of the photoelectric measurements. AUTHOR.

970. Equilibrium Distribution of Potential and of Electrons Outside the Surface of a Conductor. A. T. Waterman. *Phys. Rev.* 38. *pp.* 1497–1505, *Oct.* 15, 1931.—The potential distribution due to space charge in the neighbourhood of a plane-conducting surface is derived for the case of equilibrium under zero applied field and under retarding fields by use of Poisson's equation and the Boltzmann distribution law, which is extended to include application to the Fermi-Dirac statistics. The electron density is likewise evaluated as a function of the distance from the surface. In both cases an applied electric field has no appreciable effect within a certain critical distance which is dependent upon the field. Assuming degeneracy within the conductor the electron atmosphere is also degenerate near the surface, becoming entirely classical at distances greater than 2 or 3×10^{-7} cm. Its density is independent of the nature of the conductor and at a given distance is directly proportional to the absolute temperature. The potential at a given distance is characteristic of the conductor and varies only slightly with temperature, while its magnitude is consistent with the Sommerfeld electron theory. The field intensity equals that computed from an image force law at distances in the neighbourhood of 3×10^{-7} cm., depending upon temperature, and is increasingly greater than the latter at greater distances. The mean electron separation distance in a plane parallel to the surface is comparable with the distance of this plane from the surface. AUTHOR.

971. Electrolytic Phenomena in Oxide-Coated Filaments. J. A. Becker. *Am. Electrochem. Soc., Trans.* 59. *pp.* 207–220; *Disc.*, 220–221, 1931.—A critical survey of the literature shows that the current through the oxides in oxide-coated filaments is carried by electrons, negative oxygen ions and positive barium ions. The proportion of current carried by each depends upon the exact composition and method of preparation of the oxide coating on the heat treatment and on previous electrolytic effects. Presumably the conductivity is greatly affected by barium and oxygen dispersed through the oxide. New experimental results show: (1) For a particular BaO + SrO filament, the conductivity C was given by $1 \cdot 71 \times 10^{4} \varepsilon^{-1 \cdot 78 \times 10^{4}/T} + 5 \cdot 55 \times 10^{-3} \varepsilon^{-0 \cdot 62 \times 10^{4}/T}$. (2) The current is proportional to the voltage only so long as the current is small; otherwise the products of electrolysis alter the conductivity. (3) Polarisation currents are caused by the Ba and O which are produced by electrolysis. These currents decrease rapidly even at temperatures near 500° K., thus showing that Ba and O diffuse at low temperatures. AUTHOR.

972. Oxide Decomposition in Valves. E. R. Wagner. *Am. Electrochem. Soc., Trans.* 59. *pp.* 223–227; *Disc.*, 227–228, 1931.—An oxidised iron anode in a valve, type "245," liberated large quantities of gas during the operation of the valve. If the potential is increased above 250 volts, the emission of gas is almost instantaneous. The phenomenon does not appear to be a purely electrolytic one, but rather due to electron bombardment. Thin layer surfaces of either iron or nickel oxides decompose during operation of the valve. Anodes coated with ZrO_2 are stable under similar conditions, but show the same effect where ZrO_2 is in contact with exposed conductor. AUTHOR.

973. B.T.H. Mazda Thyratron, Type B.T.1. *Journ. Sci. Instruments*, 8. *pp.* 296–302, *Sept.*, 1931.—A description of the general properties of a thyratron which is now available commercially. The filament consumes 6·75 amperes at 2 volts, and the thyratron, which is designed for voltages up to 1000, will pass 0·15 ampere mean current (0·75 ampere peak instantaneous current) with a maximum drop of 24 volts. The various characteristics are discussed, and typical circuits involving the use of thyratrons are given. G. E. B.

974. Quartz Plate Mountings and Temperature Control for Piezoelectric Oscillators. V. E. Heaton and E. G. Lapham. *Bureau of Standards, J. of Research*, 7. *pp.* 683–690, *Oct.*, 1931.—In this paper are described a number of representative types of mountings for rectangular and circular quartz plates to be used as frequency standards. Unless the movement of the quartz plate in the holder is restricted, the frequency will change with each slight jar. A satisfactory holder for mounting a long rectangular quartz plate to oscillate in its extensional mode may be made by clamping the plate centrally perpendicular to its length between two keys, one in the face of each electrode. The electrodes are spaced by quartz washers. A plate mounted in such a holder will be constant in frequency to 1 part in 300,000. Such a mounting has not been found satisfactory for frequencies above 100 kc. as the damping caused by the pressure of the keys is too great. A very satisfactory holder for mounting a cylindrical quartz plate for "thickness oscillation" may be made by clamping the plate between three screws, mounted radially 120° apart in a ring so that they press into a V-shaped groove cut around the cylindrical surface of the quartz plate midway between the faces. The electrodes are spaced on either side of the quartz plate by pyrex washers. Mounted in such a way, the plate has been found to be constant in frequency to 1 part in 1,000,000 in a portable frequency standard with the addition of temperature control of the oscillating circuit. Some discussion is given on the subject of temperature control of the piezoelectric oscillator. AUTHORS.

975. Origin of the Third Fundamental Frequency of Oscillating Piezoelectric Quartz Crystals. E. P. Tawil. *Comptes Rendus*, 193. *pp.* 725–726, *Oct.* 26, 1931.—According to Curie's laws there should be no oscillations of a quartz crystal in the direction of the optic axis, but the author has shown that such vibrations may occur, though, unlike the other two vibrations, for which there is good agreement with Newton's formula, the measured frequency differs from the calculated one by nearly 25 %. The author now attributes these vibrations in the direction of the optic axis to the reciprocal of a phenomenon he has recently described, in which flexure of a cylinder of quartz, whose generatrix is parallel to the optic axis, causes charges of opposite sign to be set free at the ends of the axis perpendicular to the plane containing the optic axis and the applied force, whatever the orientation of this plane with respect to the electric axes. A. W.

976. Connection Between the Optical and Piezoelectric Properties of a Vibrating Quartz Plate. V. Petržilka. *Ann. d. Physik,* 11. 5. *pp.* 623–632, *Oct.* 27, 1931.—Tawil's optical method is used to examine the alteration in the properties of a quartz crystal when an oscillating electric field is applied either in the direction of the electric axis or perpendicular to it. The effect is examined by passing parallel and convergent plane-polarised light through the polished quartz in the direction of the optic axis. By means of parallel light, it is seen that the quartz plate oscillates at about fourteen different frequencies very close to the fundamental frequency. The crossed pattern, which is obtained in convergent light, is expected from the results obtained by Kundt using constant electric fields, and is verified theoretically. H. M. B.

977. Magnetic Investigations of Organic Substances. H. Buchner. *Zeits. f. Physik,* 72. 5–6. *pp.* 344–349, *Oct.* 21, 1931.—The susceptibilities of certain organic substances (ethyl alcohol, carbon disulphide, acetone, chloroform, phenol and tertiary trichlorobutylalcohol) have been investigated and found to remain unchanged by weak external influences such as admixture with other substances, water of crystallisation, etc. H. H. Ho.

978. Theory of Magnetostriction. T. Hayasi. *Zeits. f. Physik,* 72. 3–4. *pp.* 177–190, *Oct.* 14, 1931.—It is shown, starting from the expression for the potential energy of a dipole lattice, that the lattice energy of a magnetised crystal depends on the shape of the crystal. Magnetostriction is then shown to depend, not only on field and magnetisation, but also on the dimension ratio of the crystal. In illustration of this conclusion, a graph is given of the calculated magnetostriction against the dimension ratio for a single iron crystal. G. E. A.

979. Magnetostriction of Iron-Nickel Alloys. Y. Masiyama. *Tôhoku Univ., Sci. Reports,* 20. *pp.* 574–593, *Oct.,* 1931. *Report No.* 276 *of the Research Inst. for Iron, Steel and other Metals.*—The magnetostriction of iron-nickel alloys in different concentrations was measured for (i) volume change, (ii) longitudinal length change, and (iii) transverse length change. In each case an anomalous change occurred in the region of 20–35 % Ni, corresponding to a mixture of α and γ solid solutions. The transverse change of length is nearly the reverse of the longitudinal change and the volume change is the differential effect of these two. AUTHOR.

980. Magnetostriction in Single Crystals of Iron and Nickel. F. C. Powell. *Cambridge Phil. Soc., Proc.* 27. *pp.* 561–569, *Oct.* 31, 1931.—A theoretical discussion of the theory of magnetostriction of a crystal when

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193

the magnetisation is saturated. Webster has already accounted satisfactorily for the magnetisation in unsaturated states, and Akulov and Becker have applied theories to cubic crystals, both ascribing the strain produced in the crystal structure to magnetic dipole interaction. The two versions of the theory fail to lead to the same results, and the present paper seeks to investigate the causes of the discrepancy. It is shown that the theories of Akulov and Becker must refer to crystals having different bounding surfaces, and when allowance is made for this bounding surface effect then the two theories are consistent. The present work extends the theory to cover the case when the form of the crystal is spheroidal, and assumes the crystal to be elastically isotropic. The results of the present work are finally compared with experimental values and found in good agreement. S. G. B.

981. Electrical and Magnetic Effects in Metal Wires Due to Thermal, Magnetic or Acoustic Influences on Their Structure. A. v. Hippel, O. Stierstadt and O. v. Auwers. *Zeits. f. Physik*, 72. 3–4. *pp*. 266–274, *Oct*. 14, 1931.—The paper contains remarks on a recent paper [see Abstract 2805 (1931)] by v. Hippel and Stierstadt on the subject. The explanation previously given is modified in certain respects by the new results obtained. Alteration in the magnetisation of a ferromagnetic wire produces an electrical potential difference at the ends. This produces in a telephone a sound of the same quality as that due to the Barkhausen effect. If a stretched wire with remanent magnetism vibrates in a space free from magnetic field an alternating voltage is produced in it, with the same period as the elastic vibration. In a supplement **v. Auwers** describes a series of experiments which he has made on the subject, using iron, steel, nickel and permalloy. H. N. A.

982. Structure Sensitiveness of Magnetism in Metals. F. E. Lowance and F. W. Constant. *Phys. Rev*. 38. *pp*. 1547–1551, *Oct*. 15, 1931.—The magnetic susceptibilities of copper, silver, platinum and bismuth were measured for the annealed state and after various degrees of cold work. The cold work consisted of twisting, stretching and pounding. In every case the cold work decreased the diamagnetism (Cu, Ag, Bi) or increased the paramagnetism (Pt). This probably explains the variation in the measured values of metallic susceptibilities as due to a structure sensitiveness. This is attributed to the increase in the paramagnetic contribution of the partly bound electrons of the metal due to the cold work; the electrical conductivity is usually decreased. AUTHORS.

983. Diamagnetism of the Free Electron. T. Takéuchi. *Phys. Math. Soc., Japan, Proc*. 13. *pp*. 267–268, *Oct*., 1931.—It is shown that when free electrons of metals are moving in a magnetic field, they exhibit a classical diamagnetism plus a paramagnetism, the latter being due to their spin. The present paper had been prepared before the appearance of papers by Landau [see Abstract 989 (1931)] and C. G. Darwin [see Abstract 2049 (1931)]. AUTHOR.

APPARATUS AND INSTRUMENTS.

984. Lindemann Electrometer. H. Israël. *Zeits. f. Instrumentenk*., 51. *pp*. 464–472, *Sept*., 1931.—A systematic investigation of several Dolezalek electrometers showed that errors arose from after-effect. The after-effect is given by the difference between the initial charging and discharging deflections expressed as a percentage of the former. It is found that (1) for each sensitivity the magnitude of the after-effect depends on the deflection, (2) with increasing sensitivity the error increases in a linear way, and (3) the error increases with rise of temperature due to changes of elasticity and sensitivity. Examples are given of the action of the instrument when used as an ion counter and of the method of correcting the readings. R. S. R.

985. Calibration of Oil-Damped Oscillographs. E. L. E. Wheatcroft. *Journ. Sci. Instruments,* 8. *pp.* 319–324, *Oct.,* 1931.—Experimental results obtained by testing certain Duddell-type oscillographs show that such vibrators can only be considered as simple damped mechanical systems for frequencies below 2000 cycles. For frequencies higher than this the value of the damping coefficient rapidly diminishes. It is suggested that the optimum value of damping is 70 % of the critical value. AUTHOR.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

986. Apparatus for Purifying Radon. G. H. Henderson. *Canad. J. of Research,* 5. *pp.* 466–469, *Oct.,* 1931.—A description is given of a simple and efficient apparatus for purifying radon, which has given several years' effective service in connection with radium therapy. KOH is used to remove CO_2 and most of the water. Since phosphorus pentoxide for drying has been dispensed with, only one Toepler pump and fewer valves and stopcocks are necessary. The number of stopcocks has been reduced to three, and there is but one large bulb and one float valve. The impurities are removed by sparking and allowing excess hydrogen to escape through a palladium tube heated electrically; thus there is no danger of clogging the tap with particles of loose reagent. All parts are made of Gundlach glass. Purification takes from 2 to 5 min. AUTHOR.

987. Erythema as Guide in Dosage of Artificial Sunlight. M. Luckiesh. *Am. Illum. Eng. Soc., Trans.* 26. *pp.* 703–710; *Disc.,* 737–743, *Sept.,* 1931.—The so-called "dual-purpose" lighting combines with ordinary visible light a certain amount of ultra-violet in the biologically-effective region. The effectiveness of energy in producing erythema (tanning) shows a pronounced maximum in the region 2900 to 3100 Å. The author tabulates for a large number of light sources the foot-candle minutes required to produce a minimum perceptible erythema. These range from 227 for a new high-pressure quartz-mercury arc, to 280,000 for midday sunlight + skylight at the equinox. New media are required for the construction of fixtures if the ultra-violet effectiveness of a dual-purpose light source is to be conserved. [See also Abstract 964 B (1931).]

J. W. T. W.

988. Measurement of Biologically-Important Ultra-Violet Radiation. A. H. Taylor and L. L. Holladay. *Am. Illum. Eng. Soc., Trans.* 26. *pp.* 711–726; *Disc.,* 737–743, *Sept.,* 1931.—Surveys the chief methods employed in measuring the intensity of ultra-violet radiation, including the use of cadmium cells, a fluorescent photometer and the production of erythema upon untanned skin. The most biologically-active radiation is contained in a narrow spectral band at about 3000 Å. After carefully considering the various methods, the authors favour a photometric method based on the fluorescence of a special glass, sometimes used in conjunction with a filter. It is concluded that photochemical methods are in general too delicate for general use. G. E. B.

989. Industrial Uses of Ultra-Violet Light. E. E. Free and C. C. Clark. *Am. Illum. Eng. Soc., Trans.* 26. *pp.* 744–755, *Sept.*, 1931.—A general survey of the industrial uses of ultra-violet light, with special reference to its application in the tobacco industry. G. E. B.

990. Definition and Measurement of Useful Radiation of Ultra-Violet Lamps. C. H. Sharp and W. F. Little. *Am. Illum. Eng. Soc., Trans.* 26. *pp.* 727–737; *Disc.*, 737–743, *Sept.*, 1931.—It is claimed that measurements on the ultra-violet output of lamps should be based on a biological standard, possibly by their erythemal effect. The various methods of measuring intensity and of obtaining some idea of the effective wave-lengths are discussed. G. E. B.

991. Balanced Thermocouple and Filter Method of Ultra-Violet Radiometry. W. W. Coblentz, R. Stair and J. M. Hogue. *Bureau of Standards, J. of Research,* 7. *pp.* 723–749, *Oct.*, 1931.—This paper is a further contribution [see Abstract 3969 (1931)] to the investigation of filter radiometry, as applied to the measurement of ultra-violet radiation used for therapeutic purposes. The experimental procedure consisted in exposing both receivers of a thermocouple simultaneously to radiation. On covering one receiver with a filter that excludes the ultra-violet, and the other receiver with a window that freely transmits these ultra-violet rays and exactly balances the transmission losses of the exclusion filter, throughout the remaining part of the spectrum, the galvanometer deflection obtained on exposure of the two thermocouple receivers to the source is a direct measurement of the ultra-violet emitted. Data are given on the amount of ultra-violet in sunlight at midday in summer and in winter in Washington. An experimental procedure is described for testing the performance and for the standardisation of photoelectric cells, for use as ultra-violet dosage meters; also for using measured amounts of ultra-violet in physiological experiments using spectrally homogeneous (" monochromatic ") and heterogeneous ultra-violet radiation. AUTHORS.

992. Through-Type Current Transformer and Amplifier for Small A.C. Measurements. W. B. Kouwenhoven. *Rev. Sci. Instruments,* 2. *pp.* 541–548, *Sept.*, 1931. The cores consist of square section rings of either permalloy or hipernik steel, and the transformers are wound with 1500–2500 turns of 36 B. and S. silk-covered wire. The amplifier is of the three-stage resistance-coupled type. The complete system is capable of measuring currents of a few mA, such as pass, for example, through the heart of an animal undergoing electric shock. G. E. B.

993. 400 kV X-Ray Tube. V. E. Pullin and C. Croxson. *Journ. Sci. Instruments,* 8. *pp.* 282–286, *Sept.*, 1931.—The difficulty of constructing a sealed-off X-ray tube to work satisfactorily at ultra-high voltages led to the investigation of the possibility of making an X-ray tube for practical use working continuously on a pumping system. Such a tube is described. It works satisfactorily at 400 kV with a relatively high current. Owing to the bulk of the apparatus the question of protection becomes important. Further work is in progress to overcome this difficulty by operating a similar tube under adequate protective conditions. AUTHORS.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

994. Discontinuities in Adsorption Isotherms. A. F. Benton and T. A. White. *Am. Chem. Soc., J.* 53. *pp.* 3301–3314, *Sept.*, 1931.—In a study of the adsorption of gases by nickel, copper and iron, a considerable number of new examples of discontinuous isotherms have been found and the effects on the discontinuities of temperature, poisons and heat treatment of the adsorbent have been investigated. Evidence is presented to show that a step-wise increase of adsorption with pressure is a general characteristic of the physical type of adsorption, and that the steps may occur under conditions which preclude the existence of liquid films or even of multimolecular layers of gas, and, further, that the phenomenon has no direct relation to the " active spots " of catalytic theory. A new hypothesis of physical adsorption is proposed, according to which the observed steps represent the formation of concentric rows of adsorbed molecules, first at the edges of each crystal face, and building up successively towards the centre. The mechanism of adsorption in rows offers no difficulty if it is assumed that neighbouring adsorbed molecules evaporate from the surface less readily than isolated molecules, and that physically adsorbed molecules possess mobility in the plane of the surface.
H. H. Ho.

995. Influence of Hydrogen-Ion Concentration upon Adsorption of Weak Electrolytes by Pure Charcoal. H. J. Phelps. *Roy. Soc., Proc.* 133. *pp.* 155–161, *Sept.* 1, 1931.—Charcoal prepared from Whatman's No. 40 filter papers was found to adsorb *n*-propylamine and *n*-butylamine only as unionised molecules. The amount of base adsorbed at any given H-ion concentration was proportional to the concentration of unionised molecules present under these conditions. Propionic acid was adsorbed only as unionised molecules, but true equilibrium was not established between the molecules in solution and those at the surface, owing to the presence of some impurity, which could be removed by treatment with acid. It was concluded that sufficiently purified charcoal would present a perfectly neutral surface to a water solution of a weak electrolyte. Such a surface would adsorb weak acids and bases only as unionised molecules.
F. J. B.

996. Sorption of Hydrogen on Copper. A. F. H. Ward. *Roy. Soc., Proc.* 133. *pp.* 506–535, *Oct.* 1, 1931.—When hydrogen is admitted to an activated copper catalyst an instantaneous adsorption occurs, followed by a slow solution process. The difference in speed allows these to be separated and the true adsorption isotherm determined. The isotherms are not altered by baking below the temperature of preparation of the catalyst, but after sintering above this temperature the amount of gas adsorbed is decreased. The rates of diffusion of hydrogen into copper have been determined and shown to be proportional to the amount of gas adsorbed on the surface. The energy of activation of this process, which is probably grain boundary diffusion, is 14,100 cal. per gm. mol. The heat of adsorption has been measured and found to be independent of the amount of gas adsorbed. It decreased after each baking out of the copper until a final value of 9000 cal. per gm. mol was obtained. The relation of these results to Frenkel's theory of adsorption and the modern theory of "active centres" is discussed. F. J. W.

997. Diminution of the Hardness [of Crystalline Surfaces] on Adsorption of Surface-Active Substances. P. Rehbinder. *Zeits. f. Physik*, 72. 3–4. *pp.* 191–205, *Oct.* 14, 1931.—The fall of the sclerometric hardness, H, observed with a crystal after adsorption of a surface-active substance, is closely related to the decrease of free surface energy. The ΔH-concentration curves follow a course parallel with that of the corresponding adsorption isotherms. The hardness is a minimum when the surface is saturated with oriented polar molecules, and in a homologous series the magnitude of ΔH increases with increase of the tendency to orientation of the adsorbed molecules. The theoretical significance of the results is discussed; the effect may be due primarily to the lowering of the forces of cohesion in the lattice or to the widening of the existing ultramicroscopic surface cracks. The phenomenon may have many and varied technical applications, especially in processes such as grinding in ball mills, boring stone, and cutting, grinding and polishing metals and glass. The efficacy of solutions of polar substances such as camphor and colophony as cutting lubricants for glass, and of soap solutions for steel, probably depends on the fall of surface hardness consequent on adsorption of the active material. H. F. G.

998. Abnormality in Aqueous Solutions of Cadmium Salts. E. Tesche and P. J. van Rysselberghe. *Am. Electrochem. Soc., Trans.* 59. *pp.* 353–357; *Disc.*, 357, 1931.—Electrolysis of aqueous solutions of cadmium iodide yields kathode deposits containing a large amount of adsorbed cadmium iodide. Cadmium bromide behaves in the same way, while cadmium chloride yields normal deposits of pure cadmium. The phenomenon is ascribed to the adsorption of neutral molecules. An explanation of the difference of behaviour of the iodide and the bromide on the one hand, and of the chloride on the other hand, is suggested. AUTHORS.

999. Rate of Solution of a Solid Rotating in a Liquid. V. Giambalvo. *N. Cimenti*, 8. *pp.* 246–257, *July*, 1931.—Rotates a cone of alum in water or a dilute solution of alum at various speeds and finds the rate at which the alum dissolves. At low speeds the liquid is in a laminar condition, whereas at high speeds the liquid is a turbulent condition, and the amount dissolved increases in proportion to the speed. At still higher speeds, of the order of several thousand turns per min., there is supposed to be a speed of saturation where the amount dissolved remains constant. The author traced several intermediate states, but failed to attain the third state even when rotating the solid at the rate of 5000 turns per min. E. E. F. d'A.

1000. Solid Solutions between Alkali Halides. A. Baroni. *Accad. Lincei, Atti*, 14. *pp.* 215–217, *Sept.*, 1931.—The system KCl-KI has been subjected to X-ray analysis. The photograms obtained by the Debye method show, for all the mixtures, the lines of the two components, so that, in the solid state, there is not even partial miscibility between the two salts. The thermal and X-ray results obtained by other authors for the systems KCl–KBr and KBr–KI are confirmed and demonstrate that a metastable equilibrium is attained, true equilibrium being readily reached only from aqueous solutions. T. H. P.

1001. Kinetics of Variations of Distribution. M. Leontowitsch. *Zeits. f. Physik,* 72. 3–4. *pp.* 247–265, *Oct.* 14, 1931.—Gives an expression for the probability of a distribution of concentration, at a given time, in a solution, with a given initial distribution. The author's treatment of the problem, particularly for colloidal solutions, is, in some respects, more general than that of Smoluchowski. A method is given for the determination of the spectrum due to the variations of the concentration distribution, that is, the determination of the statistical mean value of the squares of the coefficients of the space-time Fourier development of the variations of the concentration, and of the density in liquids. The results of the theory, which are connected with the fine structure of the lines of the spectrum of scattered light, are discussed with relation to the existing experimental results. H. N. A.

1002. Application of the Ultra-Centrifuge to some Colloid-Physical Problems. J. B. Nichols. *Physics,* 1. *pp.* 254–267, *Oct.,* 1931.—Examples are given of various investigations carried out by the ultra-centrifuge, as, for instance, on the constitution of the proteins, on complex dyes, and on colloidal gold and ferric oxide. The work of Svedberg is particularly mentioned. J. K.

1003. Arrangement of the Molecules in Soap Micelles. P. A. Thiessen and R. Spychalski. *Zeits. f. phys. Chem.* 156. *Abt. A.* 5–6. *pp.* 435–456, *Oct.,* 1931.—The present paper refers to X-ray investigations on colloidal solutions of the alkali salts of the higher fatty acids (soaps). It is shown that the particles in the hydrosols and hydrogels are crystalline and neutral, water-free fatty acid salts. The water present in the soap gels is mostly intermicellar, filling the capillary empty spaces. X-ray photographs of arranged micelles show that the molecules of the salts of the fatty acids are arranged at right angles to the long axis of rod-like particles. Knowledge of the orientation of the molecules in the soap micelles gives indications as to the distribution of the electrical charges on the surface of the particles. J. K.

1004. Hydrocarbons as Dispersion Media. B. C. Soyenkoff. *J. Phys. Chem.* 35. *pp.* 2993–3010, *Oct.,* 1931.—Among the methods of preparation of organosols can be mentioned those of Svedberg, Hall, Haurowitz, Berl, Barth and Winnacker, who employed electrical methods. Mechanical and thermal methods have also been employed. Evidence of colloidality and electric charge is considered. Details are given for the preparation and properties of the following sols used in the electrophoretic experiments, *viz.,* Amberger's gold sol in xylene, colloidal silver in toluene, colloid arsenic in xylene, colloid nickel in toluene. Tarczynski's carbon sol in xylene, Pochettino's selenium sol in paraffin oil, colloid copper chloride in toluene, Hatschek and Thorne's nickel carbonate sol in toluene, and iron sulphide sol in toluene. It is shown that electrical factors of stability are unimportant in hydrocarbons as dispersion media. J. K.

1005. Photoelectric Determination of Mean Size of Particles in Disperse Systems. N. N. Andrejew. *Kolloid Zeits.* 57. *pp.* 42–47, *Oct.,* 1931.—From the strength of the photoelectric current arising when light passes through the light-filter on to the photo-element, the value of A^2 in Rayleigh's formula can be determined, and therefrom the constants of the formula calculated. Moreover, from these constants and the magnitude of the light dispersion, the size of the particles in the colloid system may be ascertained. The variation of the light dispersion of the colloidal solutions under the influence of electrolytes gives a means of estimating the length of the radius of the particles at which dispersion of light ceases and reflection begins. The curve representing the dependency of the light-effect on the magnitude of the particles allows of the calculation of the constants of the equation connecting the light-effect with the size of the particles reflecting the light and hence permits this size to be calculated. T. H. P.

1006. Colloidal Air. A. Krause and K. Kapitanczyk. *Kolloid Zeits.* 57. *pp.* 50–56, *Oct.*, 1931.—For the first time stable air sols have been produced. The preparation follows a condensation process. About nine parts by volume of 17 *N* NaOH solutions is mixed with one part by volume of water, whereupon the dissolved air which is molecularly dispersed in the distilled water separates out in small bubbles. It is shown that soaps have a protective action on the air sols. The influence of various factors is given, as, for instance, the addition of glycerin. The glycero-alkali-air sols show quite sharply the Tyndall phenomenon when suitably diluted with glycerin. By ultramicroscopic observations of these sols a weak but certain Brownian movement of the air particles can be recognised. J. K.

1007. Rate of Deformation of Cellulose Nitrate-Camphor Films Under Static Stresses. J. G. McNally and S. E. Sheppard. *J. Phys. Chem.* 35. *pp.* 2498–2507, *Sept.*, 1931. *Comm. No.* 464 *from the Kodak Co. Research Lab.*—The resistance to stress of cellulose nitrate-camphor films shows a discontinuity at 35 % camphor. This is explicable on the same theory as outlined by Derkson and others [see Abstract 642 (1931)] to explain the discontinuity in double refraction at 37 % camphor. 35 % camphor corresponds to an equimolecular ratio of camphor molecules and nitrated glucosan units, suggesting a stoichiometric compound, which is very unstable and resembles a solvate. Below 35 % camphor, celluloid consists of a mixture of cellulose nitrate and the complex; above 35 %, of camphor and the complex. C. B. A.

1008. X-Ray Studies of Cellulose Derivatives. C. Trogus and K. Hess. *Zeits. f. phys. Chem.* 14. *Abt. B.* 5. *pp.* 387–395, *Oct.*, 1931.—The existence of compounds of cellulose with hydrazine, ethylenediamine and tetramethylenediamine has been proved. One molecule of base is combined with one of $C_6H_{10}O_5$. The substituted molecule lies in a direction which is oblique to that of the fibre axis. The fibre period is in all cases about 10·3 Å. F. J. W.

1009. Faraday's "Steel and Alloys." R. Hadfield. *Roy. Soc., Phil. Trans.* 230. *pp.* 221–292, *Sept.* 17, 1931.—A detailed chemical, physical and metallographic analysis of a group of alloy steels prepared by Faraday. F. J. W.

1010. Colloidal Theory of Corrosion of Iron and Steel. J. N. Friend. *Faraday Soc., Trans.* 27. *pp.* 595–596; *Disc.*, 596, *Sept.*, 1931.—The corrosion of iron and steel is considered to show close similarity to the formation and precipitation of colloids [see Abstract 1214 (1922)]. Water flowing over the surface of iron was found to produce no corrosion in the ordinary sense when the rate of flow was about six miles per hour. Discs of iron were rotated in solutions of sulphuric acid at varying speeds, and it was found that the rate of solution of the iron was directly proportional to the velocity of rotation. It is concluded that the action of the colloid is simply mechanical. When the water is moving rapidly the iron passes slowly into solution, and the ferrous hydroxide is swept away. Under stationary or slow-moving conditions the ferrous hydroxide agglomerates to sol or gel, and is adsorbed on to or adheres to the surface, partially screening it from oxygen and inducing anodic corrosion. F. J. B.

1011. Effect of Hydrogen-Ion Concentration on Corrosion of Tin. J. M. Bryan. *Faraday Soc., Trans.* 27. *pp*, 606–618; *Disc.*, 618–620, *Sept.*, 1931.—The corrosion of tin in solutions of citric acid was studied by measuring the oxygen absorption during the corrosion. The pH of the citric acid was varied by adding sodium citrate as a buffer solution. It was found that the corrosion of tin was negligible in the absence of oxygen and within the range of pH studied. The addition of small amounts of ferrous citrate to the corroding solutions caused a marked acceleration of the corrosion of tin by air, especially at pH = 3. Corrosion was found to decrease with decreasing acidity in the presence of oxygen. Tin was readily attacked by a 0·5 % solution of citric acid in the absence of oxygen. F. J. B.

1012. Soil Characteristics and Pipe-Line Corrosion. I. A. Denison. *Bureau of Standards, J. of Research*, 7. *pp*. 631–642, *Oct.*, 1931. —Corrosion which has been experienced on a group of pipe-lines in Ohio is attributed to the corrosiveness of certain soils occurring along the lines. Areas occupied by different soils correspond in a general way to corrosive and non-corrosive areas, as shown by a record of pipe replacements over a period of years. The most corrosive areas are occupied by heavy, acid soils which have developed from glacial material. The chief factors influencing the corrosiveness of the soils are acidity, texture, and drainage. Values for total acidity of soil samples taken at various points along the lines indicated in a satisfactory manner the areas differing in corrosiveness. These areas were also indicated by pH values of the soil extracts in *N*-KCl solution. An accelerated test of the relative corrosiveness of soils is described. The results of this test, which is based on the corrosion of a steel disc in contact with moist soil, agreed in general with the results of the acidity tests in defining the corrosive areas. AUTHOR.

1013. Prevention of Corrosion of Metals by Sodium Dichromate. B. E. Roetheli and G. L. Cox. *Indust. and Engin. Chem.* 23. *pp*. 1084–1090, *Oct.*, 1931.—The rate of corrosion of metals by sodium chloride solutions, and the effect of additions of sodium chromate on the rate of corrosion, were investigated over a range of concentrations and temperatures. The specimens of the metals were rotated in the various solutions, which were kept aerated, and the corrosion was measured by the loss of weight. It was found that soluble chromates were an almost complete protection for iron and steel in distilled water and sodium chloride solutions of all concentrations, and at all temperatures up to the boiling points of the solutions. It was a protection for aluminium in dilute solutions at room temperatures. Chromates formed a partial protection for copper, brass, lead, zinc and galvanised iron in sodium chloride solutions at room temperatures. At elevated temperatures chromates formed very little protection for zinc in water and sodium chloride solutions.

F. J. B.

1014. Protection of Magnesium Alloys Against Corrosion. H. Sutton and L. F. le Brocq. *Inst. of Metals, J.* 46. *pp.* 53–72; *Disc.*, 73–80, 1931.—The various methods of protecting magnesium alloys against corrosion are considered. Of the methods examined the most promising appeared to be that of chemical treatment of the surface followed by the application of lanolin or a suitable enamel. Two chemical processes have been developed which afford very fair protection, *viz.*, (1) immersion for six hours in a bath containing 1½ % potassium dichromate, 1 % alum, and ½ % caustic soda, the bath being maintained at 95° C.; (2) immersion under the same conditions in a bath containing 1½ % potassium dichromate and 1½ % sodium sulphate (decahydrate). For surfaces which are in the " as cast " condition a preliminary cleaning treatment in 10 % nitric acid is necessary, but for parts machined to fine tolerances this method is too drastic. In such cases a solution of 2 % caustic soda is used. Sand-blasting as a preliminary treatment is not recommended. AUTHORS.

1015. Influence of Occluded Gas on the Mechanical Properties of Metallurgical Products. L. Guillet, A. Roux and J. Cournot. *Comptes Rendus*, 193. *pp.* 685–687, *Oct.* 26, 1931.—A continuation of former work with the object of eliminating possible errors. The results obtained confirm previous work [see Abstract 2843 (1931)]. J. K.

1016. Spectrographic Analysis of Non-Ferrous Metals and Alloys. H. W. Brownsdon and E. H. S. van Someren. *Inst. of Metals, J.* 46. *pp.* 97–113; *Disc., and Corres.*, 128–138, 1931.—The value of the spectrograph for the detection and estimation of small quantities of impurities and minor constituents in metals and alloys does not appear to be fully appreciated by chemists and metallurgists, and some reasons for the slow development of spectrographic methods of examination are suggested. The spectrograph is considered as an essential part of the equipment of a metallurgical laboratory. The possibilities and limitations of spectrographic methods are reviewed. Methods for the routine spectrographic examination of brass and some lead alloys are outlined and tables are given indicating the relationship between impurity or minor constituent concentration and relative line intensities. AUTHORS.

1017. Spectrographic Assay of Some Alloys of Lead. D. M. Smith. *Inst. of Metals, J.* 46. *pp.* 114–128; *Disc. and Corres.*, 128–138, 1931.—An account is given of the application of the spectrograph to the quantitative determination of low percentages of tin, antimony, and cadmium in lead alloys; a routine method is described specially applicable to the binary and ternary alloys of lead used in cable sheathing, etc. The method is based on standards of known composition either synthetically prepared or determined by accurate chemical analysis. One of its great practical advantages is that it is very much more rapid than ordinary chemical assay of these metals. Spark spectra are preferred as giving more consistent results than arc spectra. By simple direct comparison of spectra the constituents can be determined within the range 0·1–1 % with an accuracy of ± 10 % (thus a percentage of 0·25 would be determined with certainty as being between 0·22 and 0·28 %), and by the application of the logarithmic sector method a similar accuracy for a range up to 3 % tin can be obtained. AUTHOR.

1018. Copper-Magnesium Alloys. Part IV. The Equilibrium Diagram. W. R. D. Jones. *Inst. of Metals, J.* 46. *pp.* 395–419; *Corres.*, 419–422, 1931.—The equilibrium diagram of the alloys of magnesium and copper has been constructed from thermal and microscopic data. Magnesium and copper form solid solutions to a limited extent. At the ordinary temperature 0·02 % copper is soluble in magnesium and 2–2·2 % magnesium in copper. Two compounds Mg_2Cu and $MgCu_2$ exist which do not form solid solutions, but form eutectic series with each other and with the solid solutions of copper with magnesium, and of magnesium in copper. The compound MgCu is not formed in the solid state. A review of previous work is given. AUTHOR.

1019. Transformations in the Gold-Copper Alloys. J. L. Haughton, R. J. M. Payne and G. D. Preston. *Inst. of Metals, J.* 46. *pp.* 457–480; *Disc. and Corres.,* 502–506, 1931.—By recording autographically the variation of resistance with changing temperature of alloys of composition ranging between 20 and 70 atomic % of gold, and by measurements of the specific resistance of alloys slowly cooled to room-temperature, the transformations in alloys with compositions in the neighbourhood of those corresponding with the compounds AuCu and $AuCu_3$ have been confirmed, and the presence of another transformation in alloys approximating to the concentration of compound Au_2Cu_3 has been established. The microstructure of the alloys has been studied, and a few alloys have been subjected to X-ray examination. AUTHORS.

1020. Physico-Chemical Study of the Gold-Copper Solid Solutions. N. S. Kurnakow and N. W. Ageew. *Inst. of Metals, J.* 46. *pp.* 481–501; *Disc. and Corres.,* 502–506, 1931.—In order to investigate the transformations in alloys of gold with copper, the method of determining the electrical resistance at high temperatures and recording it by means of Kurnakow's registering pyrometers was employed. Both annealed and quenched alloys were studied. The existence of the compounds AuCu and $AuCu_3$ has been confirmed by constructing isothermal diagrams of the electrical resistance, and the limits of the solid solutions have been indicated. The nature of the formation and dissociation of both these compounds has been studied by the electrical resistance method, and the volume changes in the alloys have been determined. AUTHORS.

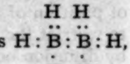
1021. Preparation and Properties of Amalgams of Titanium, Uranium and Vanadium. R. Groves and A. S. Russell. *Chem. Soc., J. pp.* 2805–2814, *Oct.,* 1931.—Amalgams of titanium, uranium and vanadium were prepared by the electrolysis of solutions in a glass cell with a mercury kathode and a platinum anode. The platinum anode was contained in a porous cell of unglazed porcelain. The cell was cooled during the electrolysis. A high current density was employed. The most suitable kathode liquids were 7 % titanous chloride in $2N$ hydrochloric acid for the deposition of titanium, uranyl sulphate in $2N$ sulphuric acid for uranium, and sodium vanadate alone for vanadium. The amounts deposited were estimated by analysis of the kathode solutions and the amalgams. The amalgams were efficient reducing agents when shaken with acidified permanganate, dichromate or ferric sulphate. The metals were removed from the amalgams by filtration through a Gooch ground-glass filter. F. J. B.

1022. Constitution of the Alloys of Silver and Mercury. A. J. Murphy and G. D. Preston. *Inst. of Metals, J.* 46. *pp.* 507–528; *Disc. and Corres.,* 528–535, 1931.—The constitution of the alloys of silver and mercury has been determined over a range of temperature extending from the melting point of silver to − 50° C. Progressive additions of mercury to silver cause a continual reduction in the temperature of the initial freezing point down to − 38·8° C., the freezing point of mercury. No alloy in the series has a freezing point lower than that of pure mercury. Silver can retain in solid solution 55 % by weight of mercury at 276° C., the amount probably increasing somewhat at lower temperatures. Two intermediate phases of restricted composition are formed. The β-phase contains 40 % of silver and dissociates on heating at 276° C. into α and liquid. This phase has a close-packed hexagonal lattice in which $a = 2 \cdot 98$ Å. and axial ratio $c = 1 \cdot 62$. The γ-phase contains 29–30 % of silver and dissociates on heating at 127° C. into β and liquid; it has a body-centred cubic lattice, with side 10·0 Å. The experimental methods devised for the investigation are described, and the effect of pressure on the constitution of the amalgams is discussed. AUTHORS.

1023. Formation and External Forms in Metallic Solid Solutions. H. Hanemann and O. Schröder. *Zeits. f. Metallkunde*, 23. *pp*. 269–273, *Oct., and pp*. 297–300, *Nov.*, 1931.—The following theory is developed: If in the original solid solutions one (I) of the two atom types is arranged on the axis of lattice in such a way that none of the other (II) atom types are arranged on the same axis, and if at the same time these axes are places of the largest distance from the other atoms (II), then all the atoms (I) may move along this axis of lattice in order to produce the segregation. This movement is called "perfusion." Perfusion goes on rapidly, is difficult to suppress, and results in large crystal segregations. The position of the crystal segregations may be explained by the construction of the "perfusion bodies." If none of the atom types lie in series allowing a perfusion, an alteration of concentration takes place by change of position of atoms I and II. It is proposed in respect to solid solutions to restrict the general term "diffusion" to this process only. Segregation by diffusion occurs slowly, is easy to suppress, and results in small crystal segregations. The external form of segregations from solid solutions depends chiefly on the orientation of the original solid solution, and not on the self-orientation of the segregations. It is found that (*a*) α-segregation of brass lies on octahedron faces, and (*b*) the β-crystals of brass along the axes of cubes. AUTHORS.

1024. Photographic Analysis of Explosion Flames. W. A. Bone. *Nature*, 128. *pp*. 589–590, *Oct*. 3, 1931. *Abstract of paper read before the British Assoc., London, Sept.*, 1931.—The method usually employed is that designed by Mallard and Le Châtelier fifty years ago. This method was developed and improved by the late H. B. Dixon and his collaborators, who also discovered the wave of "retonation." In recent years further improvements have been made in the experimental method at the Imperial College, South Kensington, where R. P. Fraser's high-speed photographic machine and a new type of camera with a mirror revolving at high speed *in vacuo* have been introduced. Important new information has been obtained on "compression" and "shock waves," and new light has been thrown on the "pre-detonation" phase of explosion. Photographs have been obtained analysing the phenomenon of "spin" in detonation, which is apparently caused by the helical rotation of a luminous "head" of detonation in the flame front, together with a long luminous tail behind it. The photographic method has also been used for analysing ignition phenomena, and the influence of moisture and of strong electrical fields on gaseous explosions. T. B.

1025. Para-Hydrogen Transformation by Tungsten and Nickel. A. Farkas. *Zeits. f. phys. Chem.* 14. *Abt.B.* 5. *pp.* 371–386, *Oct.*, 1931.—The present paper refers to investigations on the catalytic para-hydrogen transformation by tungsten and nickel. Oxygen acts on both as a strong poison. For nickel a hydride combination can be shown under certain specified conditions. Both the oxygen poisoning and the hydride formation alter the accommodation coefficient of hydrogen towards these two metals. The para-hydrogen catalysis and the accommodation effect can be uniformly explained. The ortho-para-hydrogen transformation follows the same mechanism for tungsten and nickel as for platinum. The hydrogen is adsorbed by these metals atomically and by decomposition, is given up by desorption, the equilibrium corresponding to any particular temperature of the metal. Tungsten and nickel are distinguishable from platinum in that oxygen acts as a poison on these two metals. J. K.

1026. Nature of the Chemical Bond. Part II. One-Electron and Three-Electron Bonds. L. Pauling. *Am. Chem. Soc., J.* 53. *pp.* 3225–3237, *Sept.*, 1931.—It is shown that a stable shared-electron bond involving one eigenfunction for each of two atoms can be formed under certain circumstances with either one, two or three electrons. An electron-pair bond can be formed by two arbitrary atoms. A one-electron bond and a three-electron bond, however, can be formed only when a certain criterion involving the nature of the atoms concerned is satisfied. Of these bonds the electron-pair bond is the most stable, with a dissociation energy of 2–4 v.e. The one-electron bond and the three-electron bond have a dissociation energy of about 1–3 v.e. The hydrogen molecule ion, $H.H^+$, triatomic hydrogen ion, $H.H.H^+$, boron hydrides  $H:\overset{H}{\underset{\overset{\cdot}{H}}{\ddot{B}}}:\overset{H}{\underset{\overset{\cdot}{H}}{\ddot{B}}}:H$, etc., lithium molecule-ion, $Li.Li^+$, etc., contain one-electron bonds. The helium molecule and molecule-ion, $He\overset{\cdot}{\ldots}He$ and $He\overset{\cdot}{\ldots}He^+$, nitric oxide, $:N\overset{\cdots}{::}O:$, nitrogen dioxide, $:\underset{\cdot\cdot}{\overset{\cdots}{O}}:N::O:$, and oxygen molecule, $:O\overset{\cdots}{\underset{\cdots}{:}}O:$, contain three-electron bonds. A discussion of nitroso compounds, in particular dealing with their magnetic moments, is also given. For Part I see Abstract 2876 (1931). H. H. Ho.

1027. Internal Molecular Potential of Substituents in the Benzene Ring. H. A. Stuart. *Phys. Rev.* 38. *pp.* 1372–1384, *Oct.* 1, 1931.—It is shown that differences in the observed heats of combustion of isomeric benzene derivatives can be interpreted as the internal molecular potential existing between their substituent groups. A like interpretation can be given for the differences between the values observed for the heats of combustion of certain non-isomeric benzene derivatives and those calculated by the rule of additivity. This internal potential, to which the attractive and repulsive forces between the groups are due, results from the electrostatic potential of the group moments (dipole effect), the polarisation of the substituents and of the ring (induction effect), the dispersion effect, and from steric hindrance. This constitutes a new and direct method of measuring the internal potential, which determines both the internal motion of groups within an organic molecule and its most stable configuration. The values thus measured are in good agreement with those theoretically evaluated from the intermolecular (van der Waals) forces. It is concluded that for *o*-xylene the valence angles of 120° between the C—CH_3 bond and the aromatic C—C bonds are extremely stable, whilst very restricted rotation exists in the butane molecule from which it follows that saturated aliphatic hydrocarbons in the gaseous state tend to form zigzag chains. Such restricted rotation is found also for the ether molecule. H. H. Ho.

1028. Intramolecular Potential of Substituents and its Influence on the Stability of Cis- and Trans-Isomers. H. A. Stuart. *Phys. Zeits.* 32. *pp.* 793–798, *Oct.* 15, 1931.—From the specific oscillations of certain simple molecules such as HCN, C_2H_2, CO_2 and CS_2, energy values have been determined which are necessitated by the deformation of the valency angle. In agreement with data from heats of combustion it is found that these angles are very stable, so that, in general, deformations of more than 10° are not produced by the attraction and repulsion of groups in the larger molecules, or as a consequence of thermal agitation. Data are also given for the dimensions of the effective sphere of the bound chlorine atom, and the inner molecular potentials of *cis*- and *trans*-dichloroethylene are thereby calculated. The electrostatic energy of the dipole moment, the polarisation of the double bond and the dispersion effect contribute to the above potential, and, in agreement with observation, the *cis* form is found to be the more stable. Finally, it is explained why the *cis* form of dichloroethane cannot be the most stable. H. H. Ho.

1029. Two-Component Systems Involving Compound Formation. J. Russell and O. Maass. *Canad. J. of Research*, 5. *pp.* 436–441, *Oct.*, 1931.—The two-component systems ethyl ether–hydrogen chloride and methyl alcohol–hydrogen chloride have been examined in the gaseous state, and, from the pressure-volume-temperature relationship of the binary mixture, evidence is adduced of the existence of compound formation. The heats of reaction appear to be constant in the temperature range investigated, and are 5400 cal. for the ether hydrochloride and 9200 cal. for the alcohol hydrochloride. The pressure-volume-temperature data for ethyl ether, methyl alcohol and ethyl alcohol are given over the temperature-range 50°–200° C., and over the pressure range below one atmosphere. AUTHORS.

1030. Calculations on Water-Gas Equilibrium. W. M. D. Bryant. *Indust. and Engin. Chem.* 23. *pp.* 1019–1024, *Sept.* 1, 1931.—The thermal and equilibrium data for the water-gas reaction are assembled and discussed. $\Delta H_{298\cdot1}$ for the reaction $CO_2(g), + H_2(g) = CO(g) + H_2O(g)$ is calculated to be 9751 cal. This value is combined with molecular heat equations from several sources to yield expressions for ΔH as a function of the temperature. These equations, in turn, are used to show the order of agreement existing between molecular-heat equations of different sources. For this reaction, specific heat equations of Lewis and Randall, of Eucken and of Eastman give similar results. Partington and Shilling's equations do not agree with these results. Expressions for the free-energy change, $\Delta F°$, and its temperature coefficient are derived as well as for the corresponding reaction isochores. The equilibrium value of Neumann and Köhler at 1259·1° K. is used to determine the integration constants. It is shown that the molecular-heat equations of Lewis and Randall, of Eucken and of Eastman satisfactorily reproduce the experimental equilibrium constants in the water-gas reaction. It is also shown that Partington and Shilling's molecular-heat equations fail to reproduce these values. $\Delta F^{\circ}_{298\cdot 1}$ for the water-gas reaction is calculated. Numerical results ranging from 6828 to 6750 cal. are obtained, depending on the specific heats used. These values constitute the first step in a recalculation of the free energy of formation of carbon monoxide and dioxide. H. H. Ho.

1031. Effective Cross-Section in Gas Reactions. G. Schay. *Zeits. f. phys. Chem.* 14. *Abt.B.* 3–4. *pp.* 237–240, *Oct.*, 1931.—The equilibrium constant of a bimolecular chemical reaction may be calculated statistically on the one hand by means of the chemical constants, and on the other from the gas kinetic collision data. The comparison of the two values affords a relation for the ratio of the active collision cross-sections in the forward and reversed reactions. In all known elementary processes the two cross-sections differ only slightly from each other. A connection with the thermal effect apparently does not exist. H. H. Ho.

1032. Modified Flow Method for Measuring the Velocities of Gas Reactions. E. W. R. Steacie and H. A. Reeve. *Canad. J. of Research*, 5. *pp.* 448–454, *Oct.*, 1931.—A modified flow method has been devised for measuring the velocities of gas reactions which enables observations to be made by pressure readings rather than by tedious analytical methods. In principle the method consists of passing the reactants through a flow-meter, then through a heated reaction chamber, and finally through a second flow-meter. The ratio of the two flow-meter readings, corrected for the change in the viscosities of the gases, gives a direct measure of the extent to which the reaction has progressed. As a test of the method the thermal decomposition of ammonia on the surface of silica has been investigated. AUTHORS.

1033. Action of High-Speed Kathode Rays on the Simpler Alcohols, Aldehydes and Ketones and on Ethylene. J. C. McLennan and W. L. Patrick. *Canad. J. of Research*, 5. *pp.* 470–481, *Oct.*, 1931.—The results are set forth of an experimental examination of the action of high-speed electrons on the vapours of acetaldehyde, acetone, methyl alcohol and ethyl alcohol, on gaseous formaldehyde and on ethylene. It has been shown that kathode rays form polymerisation compounds with formaldehyde, acetaldehyde and acetone, and that these suffer decomposition into the simpler gases. The ultimate decomposition of acetaldehyde has been studied in some detail and has been shown to proceed through the polymer. Exposure to the rays results in the decomposition of methyl and ethyl alcohols with the formation of aldehydes, hydrocarbons, oxides of carbon and hydrogen. The conclusion has been drawn that dehydrogenation is the principal primary reaction in the decomposition of the alcohols, further decomposition proceeding through the aldehydes. Ethylene under the action of the rays yields an unsaturated liquid hydrocarbon which upon further bombardment gives hydrogen, acetylene and saturated hydrocarbons. AUTHORS.

1034. Condensation of Hydrocarbons by Electrical Discharge. Part VI. S. C. Lind, B. M. Marks and G. Glockler. *Am. Electrochem. Soc., Trans.* 59. *pp.* 157–164; *Disc.*, 164, 1931.—It has been found that the hydrocarbons methane, ethane, propane and butane are decomposed by the high-speed electrons (125,000 volts) which are emitted through the thin glass window of a Slack-Lenard kathode-ray tube. Hydrogen is one of the products of decomposition. An estimate is made of the number of molecules reacting per electron crossing the reaction tube and of the number of ion pairs produced in the reacting gas per electron traversing it. The comparison of these ratios shows that the number of molecules reacting and the number of ion pairs formed are of the same order of magnitude. [See also Abstract 1408 (1931) and following Abstracts.]

AUTHORS.

1035. Condensation of Hydrocarbons by Electrical Discharge. Part VII. S. C. Lind and G. R. Schultze. *Am. Electrochem. Soc., Trans.* 59. *pp.* 165–180, 1931.—An accurate method is given for taking into account all temperature effects which have involved some uncertainty in judging the pressure changes during the experiments in the course of the earlier investigations [see preceding Abstract]. The properties and the applicability of the system employed for the measurements, namely, the ozoniser type of discharge, are discussed. For the acetylene condensation, a negative catalytic wall effect of the solid reaction product on the condensation velocity has been discovered. The condensation of methane, ethylene and acetylene was studied in an electrical discharge with respect to the chemical yield as represented in the M/N-ratio of the condensation where M equals the number of reacting molecules, and N the number of pairs of charges. The same proportionality was found for the M/N-ratios of methane and acetylene (2 : 20), whereas the value of the ratio for ethylene is exactly twice as high (10 instead of 5), as has been found in the α-ray work of Lind and co-workers. Recent investigations, which have been made since this paper was first written, indicate that the correlation between α-ray work and electrical discharge finds its best basis in the assumption that not the chemical yield per ion pair is the sole controlling factor, but the product of the yield (M/N-ratio) and the molecular ionisation. This brings the results for methane, ethane and ethylene in agreement, whereas the results of the acetylene runs now remain out of line, though it is believed that the low values found for acetylene will be raised upon further purification of the gas from acetone or some other inhibitor. [See also following Abstract.] AUTHORS.

1036. Condensation of Hydrocarbons by Electrical Discharge. Part VIII. S. C. Lind and G. R. Schultze. *Am. Chem. Soc., J.* 53. *pp.* 3355–3366, *Sept.*, 1931.—The present investigation relates to the influence of pressure and time on the condensation of methane, ethylene and acetylene. The effect of the electrical discharge on the liquid products of reaction has also been studied. In contrast to the reaction under influence of α-radiation, acetylene is hydrogenated in the electrical discharge to some extent. [See also preceding Abstract.] H. H. Ho.

1037. Gaseous Combustion in Electric Discharges. Part VIII. Kathodic Combustion of Hydrogen-Oxygen Mixtures. G. I. Finch and E. A. J. Mahler. *Roy. Soc., Proc.* 133. *pp.* 173–178, *Sept.* 1, 1931.—The rate of combustion of electrolytic gas at a non-sputtering kathode increases rapidly on dilution with hydrogen, the maximum rate not being reached even when the mixture contained as much as 99·5 % of hydrogen. With a freely sputtering kathode the rate increases slowly on dilution with hydrogen to a maximum value when further addition of hydrogen causes a decrease in the rate. The position of the maximum depends upon the total pressure and shifts to the region of greater hydrogen dilution as the pressure is reduced. It is suggested that (i) kathodic combustion of H_2/O_2 mixtures is primarily determined by a prior excitation of both constituents; (ii) the life of the excited hydrogen is long compared with the life of excited oxygen; (iii) sputtered metal particles reduce the life of one or both of the excited constituents. F. J. W.

1038. Study of Hydrolysis of Salts by Raman Effect. P. Krishnamurti. *Indian Journ. Phys.* 6. *pp.* 345–352, *Oct.* 31, 1931.—Raman spectra of solutions containing hydrochlorides of weak bases such as urea and hexamine at various dilutions show the effect of hydrolysis, which is indicated by the appearance of lines characteristic of the base in addition to those of the hydrochloride. The relative intensities of these two sets of lines, especially of any one strong line characteristic of each, give an approximate idea of the degree of hydrolysis. In a normal solution, urea hydrochloride shows less hydrolysis than that indicated by reaction-velocity methods. Hexamine is also shown to be a weaker base than urea, possessing only about one-third its value for the dissociation constant. AUTHOR.

1039. Relationship between Galvani Potential, Volta Potential and Adsorption of Ions which Define the Potential. M. Andauer and E. Lange. *Zeits. f. phys. Chem.* 156. *Abt.A.* 4. *pp.* 241–257, *Oct.*, 1931. The dependence of the Galvani potential and the Volta potential upon the concentration of the ions which define them is discussed. The zero points for the Galvani potential and for the Volta potential and for the ionic adsorption were obtained for the systems: Ag/Ag^+, and Hg/Hg_2^{++}. Comparison of the pairs of values obtained at the three zeros showed that the zero of Volta potential did not necessarily coincide with the zero of ionic adsorption. F. J. B.

1040. Use of Saturated Ammonium Chloride in the Elimination of Contact Potentials. C. N. Murray and S. F. Acree. *Bureau of Standards, J. of Research,* 7. *pp.* 713–721, *Oct.*, 1931.—In the electrometric measurement of the concentrations of various ions in plant extracts and other organic mixtures the potential of the junction between two electrode liquids is a source of error unless this contact potential is calculated, measured, or eliminated. The study of various concentrations of ammonium chloride up to saturation (5·66 *N*) gives a practical method for annulling the contact potential to within ± 1·0 mV. AUTHORS.

1041. Continuous Measurement of pH with Quinhydrone Electrodes. C. C. Coons. *Indust. and Engin. Chem.* 3. *pp.* 402–407, *Oct.* 15, 1931.—Quinhydrone was added to the flowing test solution, as a method for introducing it into the solution under test. Gold electrodes were found to be unsatisfactory for continuous pH measurements, and platinum gave satisfactory and reproducible results. The platinum electrodes required cleaning by boiling in a 5–10 % sodium bisulphite solution, preceded by an acid wash if necessary. For an accuracy of ± 0·05 pH on most dilute water solutions a concentration of 7 mg. of quinhydrone per 100 c.c. of solution was required. F. J. B.

1042. Hydrogen Overvoltage and Composition of Brass. M. deK. Thompson. *Am. Electrochem. Soc., Trans.* 59. *pp.* 115–119, 1931.—The hydrogen overvoltages on brass are measured for compositions varying from pure copper to pure zinc. The points on the overvoltage-composition graph would lie nearly evenly distributed about a straight line drawn between the values for pure copper and pure zinc, except for a decided minimum in ϵ-brass. Maxima have been found in other alloys, but this is the first sharp minimum. There is no close connection of the overvoltage with the equilibrium diagram. AUTHOR.

1043. Electrode Potential of Manganese. H. D. Royce and L. Kahlenberg. *Am. Electrochem. Soc., Trans.* 59. *pp.* 121–133, 1931.—Four Mn-Ag alloys were prepared from highly purified materials. Electrode potentials and replacing power of these alloys have been measured. The replacing power and potential of alloy D (31 atomic % Mn) were correlated with alloy structure by means of photomicrographs and thermal diagrams. None of the Mn-Ag alloys yields electrode potential approaching that of manganese amalgam. Manganese amalgam consists of solid Mn_2Hg_5 in equilibrium with a very dilute solution of Mn in Hg (0·0032 % Mn). The behaviour of manganese amalgam in contact with manganese salt solutions has been interpreted on the basis of these figures. A new compound of Mn and Hg, isolated from the dilute amalgam by the application of pressures exceeding 150,000 lbs. per sq. in. (10,500 kg./sq. cm.) and having the formula MnHg, is described. MnHg constitutes the stable solid phase in the system manganese-mercury at temperatures between 86° and 100° C. Pressure-concentration curves are presented to justify the assumption that the solid phase obtained by pressure is MnHg contaminated with a small percentage of the liquid amalgam. [See also Abstract 3343 (1928).] AUTHORS.

1044. Zinc Electrode. F. H. Getman. *J. Phys. Chem.* 35. *pp.* 2749–2757, *Sept.*, 1931.—The e.m.f. of the cell $Zn/ZnCl_2(M)/Hg_2Cl_2/Hg$ was measured over a range of concentrations from 0·002 to 1·0 M. Electrodes were prepared of both polycrystalline and single crystal zinc. The single crystal electrodes were found to develop a slightly greater difference of potential toward the electrolyte than the polycrystalline electrode. The normal electrode potential of zinc was calculated by three different methods, and the average of the three results gave as the probable value for the electrode potential of zinc, Zn/Zn^{++}, $E = 0{\cdot}7613$ volt. F. J. B.

1045. Glass Electrode. D. A. MacInnes and D. Belcher. *Am. Chem. Soc., J.* 53. *pp.* 3315–3331, *Sept.*, 1931.—Continuing previous work [see Abstract 2373 (1930)], electrodes were prepared of glass membranes of the order of 0·001 mm. in thickness, and comparisons were made of the glass and hydrogen electrodes through a wide range of pH, under conditions which permitted great accuracy of measurement. From pH values 2 to 8 the two electrodes agreed within less than ± 0·0002 mV. Above pH = 8 deviations occurred which depended upon the nature of the positive ions present. Resistance measurements made by a.c. methods on glass electrodes indicated that most of the apparent resistance obtained by d.c. measurements was due to polarisation. Drying the electrodes caused great increases in their resistances, even when the drying was carried out at room temperature. Theories are discussed to explain the operation of the glass electrode. F. J. B.

1046. Temperature Coefficient of the Antimony Electrode. Part II. G. P. Awsejewitsch and J. J. Shukoff. *Zeits. f. Elektrochem.* 37. *pp.* 771–775, *Oct.*, 1931.—The use of antimony electrodes for the determination of hydrogen-ion concentrations was described in a previous communication [see Abstract 408 (1930)]. Electrodes were prepared by the electrolysis of antimony trichloride dissolved in acetonitrile and other organic solvents. The change in e.m.f. with temperature was measured for a number of such electrodes at temperatures ranging from 7° to 30° C. The measurements were made against the normal calomel electrode, and various buffer solutions with different pH values were used. A linear relationship between the observed e.m.f. and the pH values was obtained for each temperature. F. J. B.

1047. Preparation of Fluorine by Electrolysis. L. M. Dennis, J. M. Veeder and E. G. Rochow. *Am. Chem. Soc., J.* 53. *pp.* 3263–3269, *Sept.*, 1931.—The cell consists essentially of two pieces of heavy 2-in. copper tubing, united at 70° to form a V, and of size to contain 1 kg. electrolyte. The electrodes are of silicon-free graphite held in position by bakelite cement. The electrolyte is pure KF . HF dried for 48 hr. at 130°. HF is completely removed by granular NaF. A current of 5 amperes at 12 volts is normally used, but for more rapid production may be increased to 10 amperes at 18 volts. Fluorine is evolved immediately on passage of the current. Electrolysis is continued until the melting point of the electrolyte exceeds 280°. The efficiency is about 70 % with a current of 9·3 amperes. Previous difficulties were mainly due to impurities—silicon in the electrodes, and silicon, magnesium and water in the electrolyte. Foaming is avoided by the width of the copper tubing. C. A. S.

1048. Electrochemistry Applied to Glass. A. Silverman. *Am. Electrochem. Soc., Trans.* 59. *pp.* 71–79; *Disc.*, 79–80, 1931.—The paper discusses accessory applications of electrochemistry to glass manufacture, for example, conductivity as a control of viscosity, electrical precipitation in purifying producer-gas, chromium-plating of moulds, and electroplating of the finished product with various metallic coatings. It also indicates some possibilities in the applications of electrochemistry to the manufacture and decoration of glass. A review is given of studies that have been conducted on the electrochemical properties of glass, such as conductance through the glass in d.c. electrolysis. AUTHOR.

1049. Electrodeposition of Platinum, Palladium and Rhodium. W. Keitel and H. E. Zschiegner. *Am. Electrochem. Soc., Trans.* 59. *pp.* 273–275; *Disc.*, 275, 1931.—The chloride plating bath for platinum metals is not satisfactory, due to its short life. A new bath was accordingly developed in which the platinum is present as amminonitrite. Good, bright adherent deposits are obtained. The throwing power is very good. A similar bath for palladium was likewise developed and has given very satisfactory results. AUTHORS.

1050. Limiting Current Density in Electrodeposition of Noble Metals. S. Glasstone. *Am. Electrochem. Soc., Trans.* 59. *pp.* 277–284; *Disc.*, 284–285, 1931.—The literature of electrochemistry does not appear to contain a simple equation permitting the calculation of the maximum, or limiting, current density at which a metal can be deposited with 100 % current efficiency. Such an equation is now developed on the assumption that the maximum rate of deposition is equal to the maximum rate at which the ions containing the metal to be deposited can diffuse up to the kathode. The values calculated in this manner are shown to be in good agreement with those observed, although discrepancies may arise when there is a possibility of hydrogen evolution. AUTHOR.

1051. Electrolytic Oxide Protective Films on Aluminium. H. Röhrig. *Zeits. f. Elektrochem.* 37. *pp.* 721–724; *Disc.*, 724; *Aug.-Sept.*, 1931. *Paper read before the Deut. Bunsen-Gesell., Vienna, May*, 1931.—The literature on this question is summarised, the principal points discussed being the conditions of formation of these anodic films, their mechanical, electrical and other properties, and the technical applications of aluminium protected by these films. T. H. P.

1052. Anodic Precipitation of Lead Peroxide. M. L. Nichols. *Indust. and Engin. Chem.* 3. *pp.* 384–385, *Oct.* 15, 1931.—The results of experiments on the anodic precipitation of lead peroxide from solutions containing fairly large amounts of nitric acid confirm Jewett's conclusion [see Abstract 416 (1930)] that the lead is not carried to the anode as ion, but is merely brought into contact with the anode by stirring the solution. If the lead is first oxidised to $Pb(NO_3)_4$, and the lead peroxide formed from this by hydrolysis, it should be possible to decrease the rate of deposition of the lead peroxide with high rates of anode rotation, as the hydrolysis would take an appreciable time. As this is not the case, Töpelmann's conclusion that the intermediate formation of $Pb(NO_3)_4$ plays a very subordinate rôle is confirmed. It appears, therefore, that the anodic precipitation of the peroxide occurs by the lead being carried mechanically to the anode and there oxidised to negatively-charged lead peroxide, which is pressed against the anode by anaphoresis. This explains why a rough-surfaced anode must be used, and since the negatively-charged lead peroxide is probably a hydrated oxide, the difficulty of removing the last traces of water in the drying of this precipitate is readily understood. T. H. P.

1053. Deposition Potentials of Copper in Cuprous Solutions. N. Thon and J. Pinilla. *Comptes Rendus*, 193. *pp.* 661–664, *Oct.* 19, 1931.—Copper was deposited from solutions of halides or sulphocyanides in presence of an excess of HCl or alkaline chloride. There was no visible development of hydrogen. Proceeding from feeble to greater current densities, the depositing potential suddenly diminishes considerably. The authors consider that at a certain density the cuprous form of the metal is formed at the kathode by a thermal reaction. The current density at which the transition occurs is $0 \cdot 5$ mA/cm^2. in the case of chlorides and bromides, and less in the case of the iodides. It is increased by acidifying the solution. E. E. F. d'A.

1054. Cataphoresis of Suspended Particles. Part I. Equation of Cataphoresis. D. C. Henry. Part II. New Experimental Method and Confirmation of Smoluchowski's Equation. C. G. Sumner and D. C. Henry. *Roy. Soc., Proc.* 133. *pp.* 106–129 *and* 130–140, *Sept.* 1, 1931.—In Part I expressions for the cataphoretic mobility of rigid spheres and cylinders of any desired electrical conductivity, and for the electroosmotic velocity at plane surfaces, or in cylindrical channels of any cross-section are derived under certain restrictions which are believed to be rigorous. Provided the radius of curvature of the particle is large compared with the effective thickness of the electrical double layer, the cataphoretic mobility, U, of an insulating particle, and the electroosmotic velocities at the surfaces considered are found to be given by Smoluchowski's equation $U = Dx\zeta/4\pi\eta$, where x is the applied field strength, ζ the potential difference across the double layer, D the dielectric constant, and

η the viscosity of the medium. For particles, *e.g.*, those in colloidal solutions, the size of which is not large with the effective thickness of the electrical double layer, the cataphoretic mobility varies with the size, tending towards the value $U = Dx\zeta/6\pi\eta$ for very small particles. Experimental evidence derived from the literature of the subject confirms Smoluchowski's equation for spherical particles of microscopic size, and suggests that the cataphoretic mobility of relatively large particles is independent of their shape. In Part II Smoluchowski's equation is confirmed in the case of the cataphoresis of cylindrical glass fibres. J. S. G. T.

1055. Interfacial Tension and Hydrogen-Ion Concentration. R. A. Peters. *Roy. Soc., Proc.* 133. *pp.* 140–154, *Sept.* 1, 1931.—Long chain carboxylic acids, *viz.*, palmitic, stearic, lauric and capric acids, show regular changes in interfacial tension against aqueous " buffered " solutions as the hydrion concentration of these is altered. A fall of interfacial tension starts at pH 5·5 and extends over the range of pH, 4·0–9·3, tending to vanish at this last value. The concentration-tension curve is not identical with a dissociation curve, though it extends over the same range of pH. For a given pH, the results are identical for phosphate and glycine " buffered " solutions, and for all acids investigated except capric acid, which shows an abnormality for phosphate. Hexadecylamine shows similar changes, in the opposite sense over approximately the same pH range, and these follow the dissociation curve of a weak base. The values of K_a and K_b of $-$ COOH and $-$ NH_2 in the interface are found to be $3{\cdot}2 \times 10^{-8}$ and $1{\cdot}0 \times 10^{-7}$ respectively. Ethyl palmitate shows a fall of interfacial tension of similar type to that for the carboxylic acids, but starting at a more alkaline point. Hexadecyl alcohol shows no change. The significance of the results in the interpretation of the activities of the living cell is briefly discussed. J. S. G. T.

1056. Dissociation of Acid-Base Indicators in Ethyl Alcohol. I. M. Kolthoff. *J. Phys. Chem.* 35. *pp.* 2732–2748, *Sept.*, 1931.—The properties of pure alcohol as a solvent, the change of the dissociation caused by adding small amounts of water to alcoholic solutions of acids, and the application of theoretical considerations to the properties of acid-base indicators in pure and in aqueous alcohol are discussed. The colour of pentamethoxytriphenylcarbinol in an alcoholic buffer solution changes considerably towards the alkaline side on addition of traces of water, this exceptional behaviour being attributed to the pseudo-basic character of the indicator. The colour of an indicator acid in an aqueous buffer solution of an uncharged acid and its salt is scarcely affected by alcohol, whereas that of an indicator base is changed strongly to the alkaline side; a simple means is thus furnished of deciding whether an indicator is an uncharged acid (or acid anion) or an uncharged base (kation acid). Titration of weak uncharged acids or bases in alcoholic medium has no advantages over titration in aqueous solution. On the other hand, salts of uncharged bases too strong to be titrated in aqueous medium may be titrated in alcoholic solution. Similarly, salts of acids which are too strong to permit of titration in aqueous solution may be titrated in alcohol, using an alcoholic solution of hydrochloric acid as titrant and methyl orange as indicator. The effect of traces of water on the increase of the dissociation of weak acids in alcohol limits the practical applicability of titration of this type. T. H. P.